NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

INTRANET-BASED DECISION SUPPORT FOR THE MARINE AIR GROUND TASK FORCE AVIATION COMBAT ELEMENT

by

Malcolm LeMay

September 1998

Thesis Advisor: Suresh Sridhar
Associate Advisor: Barry Frew

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE September 1998	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE : INTRANET-BASED DECISION SUPPORT FOR THE MARINE AIR GROUND TASK FORCE AVIATION COMBAT ELEMENT

5. FUNDING NUMBERS

6. AUTHOR(S)
Malcolm LeMay

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the authors and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

Information technology can be an effective force multiplier for the Air Combat Element (ACE) of the Marine Air Ground Task Force (MAGTF). Through the use of Intranet-based decision support, internet technology can be leveraged to improve the decision support and information processes of the ACE. This thesis reviews the objectives of Intranet-based decision support and provides a methodology to follow for implementing Intranet-based decision support for the ACE. The methodology combines systems development life cycle (SDLC) practices, command and control theory, an organizational analysis of the ACE, and prototyping to achieve Intranet-based decision support. The results from a process analysis are evaluated to select suitable processes for migration to Intranet-based decision support. Prototype development involves coding approximately 100 software files in Cold Fusion. As part of the prototyping process, comments from fleet-based Marines are collected and incorporated in the prototype when possible. The methodology developed for this project could be used for other MAGTF related Intranet-based decision support systems.

14. SUBJECT TERMS Intranet, Marine Air Ground Task Force (MAGTF), Air Combat Element (ACE), Intranet-based decision support.			15. NUMBER OF PAGES 226
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFI- CATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

Approved for public release; distribution is unlimited

INTRANET-BASED DECISION SUPPORT FOR THE MARINE AIR GROUND TASK FORCE AVIATION COMBAT ELEMENT

Malcolm B. LeMay
Major, United States Marine Corps
B.S., U.S. Naval Academy, 1983
M.A.I.S., Old Dominion University, 1992

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 1998

Author: Malcolm B. LeMay
Malcolm B. LeMay

Approved by:

Suresh Sridhar, Thesis Advisor

Barry Frew, Associate Thesis Advisor

for
Reuben T. Harris, Chairman, Department of Systems Management

ABSTRACT

Information technology can be an effective force multiplier for the Air Combat Element (ACE) of the Marine Air Ground Task Force (MAGTF). Through the use of Intranet-based decision support, internet technology can be leveraged to improve the decision support and information processes of the ACE. This thesis reviews the objectives of Intranet-based decision support and provides a methodology to follow for implementing Intranet-based decision support for the ACE. The methodology combines systems development life cycle (SDLC) practices, command and control theory, an organizational analysis of the ACE, and prototyping to achieve Intranet-based decision support. The results from a process analysis are evaluated to select suitable processes for migration to Intranet-based decision support. Prototype development involves coding approximately 100 software files in Cold Fusion. As part of the prototyping process, comments from fleet-based Marines are collected and incorporated in the prototype when possible. The methodology developed for this project could be used for other MAGTF related Intranet-based decision support systems.

TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

Information technology provides the Marine Corps with an outstanding force multiplier. In this age of decreased defense budgets and increased operational commitments, the Marine Corps must continue to seek new ways to exploit the advantages of information technology. This thesis describes methodologies to leverage one aspect of information technology, Intranet-based decision support, for the purpose of improving the capabilities of the Marine Corps Aviation Combat Element (ACE). This section provides an overview of the sequence of events that contributed to this thesis project.

In June 1996, the director of the Air Defense Systems Division (ADSD) of the Marine Corps Tactical Systems Support Activity (MCTSSA), Lieutenant Colonel Tim Kirk, released a memorandum to Marine students at the Naval Postgraduate School. The memorandum proposed a thesis topic involving research and evaluation of Internet and intranet technologies to support the Aviation Combat Element (ACE) of the Marine Air Ground Task Force (MAGTF). The subject line of this memorandum clearly stated LtCol Kirk's interests:

> DEVELOP A DESIGN AND IMPLEMENTATION PLAN FOR ESTABLISHING INTRANET SERVICES FOR THE AVIATION COMBAT ELEMENT OF THE MAGTF. [Ref. 1]

In January 1997, Mr. Albert Taschner, the acting director of ADSD, was contacted and provided additional information and details about ADSD's plans for an ACE Intranet. At that time the ADSD was in the process of fielding several new computer systems for the ACE that incorporated web browsers and he expressed interest in leveraging web server technologies to share information between these systems. In March 1997, an initial meeting occurred at Camp Pendleton, CA at the MCTSSA compound to gather initial requirements and refine the scope of the project. During this meeting ADSD representatives expressed their desire to leverage Intranet technologies for the ACE but had no strong recommendations on where to start. Essentially, the format and objectives of the project were left to the author to determine.

In June 1997, the author met with key personnel from the 3rd Marine Air Wing (MAW) at Marine Corps Air Station El Toro, CA. The meeting provided an opportunity to study the functions, processes and requirements of the ACE. In July 1997, the author returned to El Toro to observe Marine Expeditionary Force Exercise 1-97 (MEFEX 1-97). This exercise provided an excellent opportunity to observe 3rd MAW operating as the ACE for the 1st Marine Expeditionary Force (I MEF). MEFEX 1-97 involved no actual squadrons or aircraft as the exercise focused strictly on the operations and functions of the ACE and I MEF staffs. MEFEX 1-97 provided a wealth of information about the processes and functions required of an ACE. The data collected from MEFEX, a review of Marine Corps doctrinal publications on ACE operations and the author's own 13 years

of operational experience in Marine Corps aviation provided sufficient information for an analysis of the ACE processes.

After completing the analysis of the ACE processes, several processes were selected as candidates for migration to Intranet-based decision support. The details of the ACE processes are contained in Appendix A. The results of the process analysis to determine suitability for Intranet migration are contained in Appendix B. The selection of ACE processes for migration is described in Appendix C.

Prototyping for the Intranet-based decision support system began in January 1998 and was completed in March 1998. In March 1998, several Marine officers with a variety of aviation and operational backgrounds were contacted to evaluate the prototype. Their comments and feedback were reviewed and incorporated into the prototype if possible and their input is summarized in Appendix D.

B. OBJECTIVE

From the start of this thesis, the goal has been to research and develop an Intranet-based decision support tool that contributes to the readiness, interoperability and performance of Marine aviation and enhances the situational awareness and decision making abilities of the ACE. The objective of this research is to leverage Intranet technology to support ACE decision making processes and the flow of information between the hierarchical levels of the ACE during operations. The ACE operates in a highly dynamic, fluid environment where access to current information is vital to the

success of the mission. Many ACE decision making processes still rely on Marines posting mission critical information on paper and grease boards. To be of any value to the ACE, Intranet-based decision support must enhance the flow of information within the ACE and be compatible with the existing information technology architecture of the ACE. The Intranet-based decision support prototype developed for this thesis meets both of these criteria.

C. SCOPE AND METHODOLOGY

1. Scope

This thesis details the research conducted to determine the decision making processes and information flows of the ACE suitable for migration to Intranet-based technology. This thesis also details a methodology for developing Intranet-based decision support for the ACE. The scope of this thesis includes the following:

- A review of the objectives of Intranet-based decision support.
- Discussion of a methodology to develop Intranet-based decision support for the ACE.
- A review of the environment, mission, strategy, tasks, information systems, and structure of the ACE.
- An analysis of the processes and information requirements of the ACE.
- A study of the ACE decision making processes, functions and information requirements to determine candidates for migration to Intranet-based decision support.
- Development of an Intranet-based decision support prototype for the ACE.

2. Methodology

To complete this project, the author applied the methodology of the systems development life cycle (SDLC) along with the concept of prototyping to develop a working prototype. The SDLC methodology includes project identification and selection, project initiation and planning, analysis, logical design, physical design, implementation, and maintenance.[Ref. 2] Due to time and resource constraints and the inherent nature of prototypes, this project did not go beyond the logical design phase. For this project, the SDLC phases involved the following:

a. Project identification and selection

The 5 June 1996 memorandum released by MCTSSA signaled the completion of this phase. Based on their recognition of the potential of web-browser technology, MCTSSA concluded that a NPS thesis student could conduct the initial research to leverage Intranet technology for the ACE.

b. Project initiation and planning

Following the initial meeting with ADSD personnel, the author concluded that there was sufficient time and resources available to complete the study.

c. Analysis

During this phase the author studied the processes, functions, tasks, and current information systems of the ACE. To better understand the ACE organization and support the analysis sub-phase of requirements determination, the author applied the rational systems frame developed by Erik Jansen.[Ref. 3] The analysis phase also includes a sub-phase of requirements structuring. Requirements structuring involved modeling the processes of the ACE with data flow diagrams, and completing a conceptual data model of the ACE with entity-relationship diagrams.

d. Logical design

This phase includes designing forms, designing interfaces and dialogues, and designing logical databases. This phase involved structuring the findings from the previous phases into a prototype. The forms and reports of the prototype were derived from the current forms and reports utilized by ACE personnel.

D. ORGANIZATION OF THESIS

This section highlights the different sections of the thesis.

1. Chapter I Introduction

This chapter provides the reader a brief overview of the genesis for this thesis, the scope of thesis, and a short description of the methodologies followed during the thesis project.

2. Chapter II Intranet-Based Decision Support

This chapter explains the concepts behind Intranet-based decision support and how it supports the processes of an organization. This chapter also describes a methodology for developing Intranet-based decision support for the ACE with implications for other MAGTF and military organizations.

3. Chapter III Overview Of The Aviation Combat Element (ACE)

This chapter applies the rational systems frame to explain the ACE organization. The mission and strategy of the ACE are identified and the tasks required to support the strategy are explained in detail.

4. Chapter IV Prototype Development Using The SDLC

This chapter provides a description of the processes selected for migration to Intranet-based decision support. This chapter describes the critical success factors for each process, reviews the process and data models of those processes, and provides a description and screen shot of the process as it appears on the prototype.

5. Chapter V Software And Hardware Support For The Prototype

This chapter describes the software tools used for the prototype and lists the characteristics of the hardware components used to develop the prototype.

6. Chapter VI Lessons Learned And Recommendations

This chapter describes some of lessons learned from the project and provides suggestions for areas of future enhancements to the prototype as well as other recommendations.

E. ABBREVIATIONS AND ACRONYMS

ACE	Air Combat Element
ACO	Airspace Control Order
ADSD	Air Defense Systems Division
ATO	Air Tasking Order
COA	Course of Action
DFD	Data flow diagram
EC	Electronic Combat
E-R	Entity-relationship
JFACC	Joint Force Air Component Commander
JTF	Joint Task Force
MACG	Marine Air Control Group

MAG	Marine Air Group
MAGTF	Marine Air Ground Task Force
MAW	Marine Air Wing
MCTSSA	Marine Corps Tactical Software Support Activity
MEF	Marine Expeditionary Force
MEFEX	Marine Expeditionary Force Exercise
MSN	Mission
MWSG	Marine Wing Support Group
OCA	Offensive Counter Air
ODO	Operations Duty Officer
PKG	Package
SDLC	Software Development Life Cycle
UHF	Ultra High Frequency

II. INTRANET-BASED DECISION SUPPORT

A. INTRODUCTION

The rapid growth of the Internet and Internet-based technology has led to the development of new technologies and concepts that allow organizations to share information and improve productivity. The concept of an Intranet allows organizations to capitalize on Internet-based technologies for internal purposes. Due to the ease and flexibility of web-browser technology, the use of an Intranet in providing organizational decision support offers several advantages. Organizational users can access a wide variety of different types of information in several formats (e.g., text, graphics, audio and video). The user can view the information in various levels of detail by "drilling down" into the information through the use of hyperlinks. Web-browser technology allows the user to access a larger volume of information than would normally be available to him. Finally, the web-browser technology of an Intranet allows the user to access all available information from any part of the organization.[Ref. 4]

By combining web technology with database technology, organizations can maximize the strengths of both technologies. John Whetzel lists four key advantages offered by using web-based database technology:

- Ease of administration – users and database administrators do not need direct access to the database, but instead can go through a web server.
- Deployment – Web based databases can be developed and deployed to easily support multiple platforms and multiple locations.

- Development speed – Web technology allows applications to be developed and updated quickly and relatively painlessly.

- Flexible information presentation – Large documents can be broken down into different levels using web technology and the concept of "drill down." A user can be presented with an overview of all the information in a document and then opt to "drill down" for more details in areas of interest. [Ref. 5, p. 43-44]

Having summarized the inherent advantages of web-based database technology, this chapter describes concepts for leveraging these advantages into Intranet-based decision support. Possible objectives of Intranet-based decision support for an organization are discussed, and key methodologies and guidelines to develop effective Intranet-based decision support are reviewed.

B. OBJECTIVES OF INTRANET-BASED DECISION SUPPORT

To fully optimize the advantages of web-based database technology, organizations should develop Intranets with specific objectives or roles in mind. One of the most significant roles an Intranet can have in an organization is to provide the tools and environment that will enhance decision making for the organization. Examples of possible decision support objectives for an organizational Intranet are described below.

1. Improve Access To Organizational Data

To support decision making requirements, organizations require access to databases residing in computers. Prior to the introduction of Intranets, access to the information in these databases was limited to those with access to the computers. As the

information in the database changed, users without continuous access to the computers faced the problem of having outdated information in their hands. By integrating web and database technology into Intranet-based databases, organizations can overcome these shortfalls by allowing anyone with access to a web-browser to view the most current information in the database. Updates to the database are immediately available for all to see and use. In their work, *Reengineering the Corporation*, Michael Hammer and James Champy discuss changes brought about by database technology. Previously, the limitations of the file folder forced organizations to rely on sequential processes as folders were shuffled between workers. Database technology enabled workers to operate in parallel as they share access to the database.[Ref. 6] Web-based database technology has further enhanced the ability of workers to operate in parallel. With database information available over an Intranet, workers with the proper connectivity and a web browser can work with the database information from almost anywhere.

2. Support Organizational Processes

Organizations routinely perform processes that require extensive collaboration between groups and individuals. These processes could include collaboration while making long range plans for the organization or while reviewing historical information in the organization's repository on previous operations or projects. As an organization changes and evolves, the standard operating procedures, strategies, tasks and objectives of the organization will likely change. Intranets provide an excellent avenue to facilitate

the process of implementing changes to the organization. By posting the changes on the Intranet, individuals and groups can rapidly incorporate the changes and be assured that the entire organization is making decisions based on the changes.

3. Manage Organizational Assets

An Intranet that displays the current and projected status of an organization's critical assets enables decision-makers to optimize the use of those critical assets. As an example, in order to maximize utilization of its resources, the operations department of a freight delivery company continually tracks how many trucks and drivers will be available at any given time to make deliveries. Posting and maintaining information on the status and availability of trucks and drivers over a company Intranet facilitates the decision making abilities of the people who schedule the company's critical resources.

4. Share Organizational Knowledge

As individuals of an organization tackle new projects and learn new methods, their knowledge needs to be passed on to other members of the organization. These "lessons learned" are vital for any organization to avoid making the same mistakes over again in the future. An organizational Intranet provides an excellent means of quickly and easily distributing this type of information. Access to the "lessons learned" from previous projects enables decision-makers and project teams to make better decisions on future projects.

5. Improve Organizational Efficiency

Decision making processes require both horizontal and vertical communication. An organizational Intranet would not only offer the benefits of email, but could streamline the communication requirements of the organization as well. Rather than relying extensively on phone calls, memos, faxes and letters, an Intranet provides the organization with the means to efficiently distribute and post accurate information for all users to easily view. The continuous process of seeking access to rapidly changing information by returning phone calls, reading emails and receiving faxes takes up the valuable time of decision-makers. A decision-maker's time would be more efficiently used by making required information available at all times through the use of an Intranet. Each division can efficiently provide its required information to the decision make through their page on the organizational Intranet. As Melanie Hills notes in her book, Intranet Business Strategies, "Intranets provide timely access to people and information in order to help you (the decision maker) make better decisions."[Ref. 7, p. 58]

C. METHODOLOGY FOR INTRANET-BASED DECISION SUPPORT

Having discussed the roles or objectives for Intranet-based decision support, it is time to consider a possible methodology for implementing Intranet-based decision support. The methodology used for this thesis project includes the following steps:

- Understand the different types of information involved in decision making. Ensure the decision maker is provided with quality information and that the information is properly managed. Described in Chapter II.

- Conduct an analysis of organizational processes. Based on the results of the analysis, determine the suitability of the information processes for migration to Intranet-based decision support. Described in Chapter III and Appendix A.

- Conduct an analysis of the organization to determine and fully understand its environment, missions, strategy, tasks, structure, information and control methods, and its culture. Described in Chapter III.

- Once the process analysis and organizational analysis have been completed, begin prototype development. Described in Chapter IV.

Before starting a discussion on the methodology for developing Intranet-based decision support, it is important to understand some key concepts in command and control. Since the objective of this thesis project is to enhance the situational awareness and decision making abilities of the ACE, a brief review of Colonel John Boyd's Decision and Execution Cycle is required (also known as the OODA loop for Observe-Orient-Decide-Act). According to the OODA loop, situational awareness is achieved when a decision maker orients himself to the situation by forming a mental picture based on the information received. Once the decision maker understands this information he can then make a decision and execute or act on his decision.[Ref. 8, p. 18-19]

Intranet-based decision support for the ACE emphasizes information exchanged between the Orient and Decide phases of the ACE's OODA loop. Therefore, it is important to understand the different levels of information involved in the Orient phase. Jeffery Cooper developed an information hierarchy model to define the type of information a decision maker needs to orient himself to a situation.

1. Information Hierarchy

Cooper lists four classes of information that provide different values in supporting decision making. The first class is raw data. Raw data includes signals picked up by sensors, data bits transferred between computers, and transmissions between fax machines. Raw data has not been "processed, correlated, integrated, evaluated, or interpreted in any way." [Ref. 9, p. 45]. Until the raw data has been processed it provides little meaning.

The second class is processed data that has been put into a form that enables people to use the data as intended. This means deciphering the signal, displaying the data bits, and reading the facsimile. The processed data provides greater value to the user than raw data. Knowledge is the third class of the information hierarchy. Knowledge involves deriving meaning and value from the processed information to determine "reliability, relevance and importance." [Ref. 9, p. 46]

Understanding represents the final class of information. Understanding implies that the knowledge has been "synthesized and applied to a specific situation to gain a deeper level of awareness of the situation." [Ref. 9, p. 47] Achieving understanding enables a decision-maker to arrive at a decision. Figure 1 displays Cooper's information hierarchy.

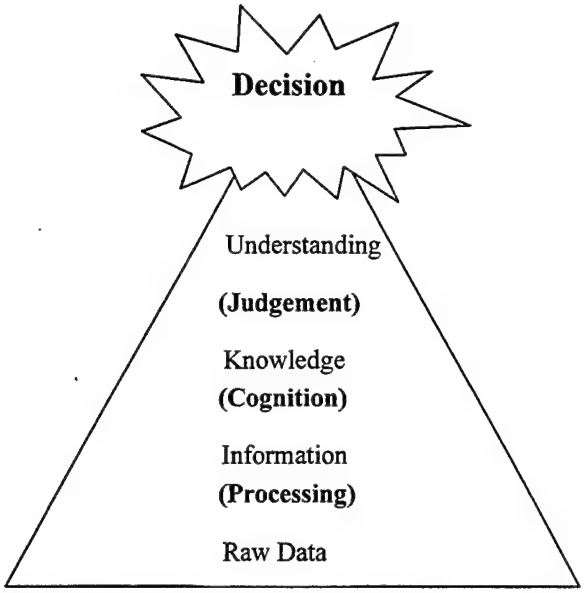


Figure 1. Information hierarchy [Ref. 8, p. 47]

2. Information Quality

As Cooper's information hierarchy reveals, the decision-maker applies judgement to the information to gain understanding. This implies that the information must be presented in such a way that offers the decision maker the best opportunity to grasp its meaning. While developing a multi-service tactics, techniques, and procedures publication for Joint Task Force (JTF) Headquarters Information Management (JTF-IM), the Air Land Sea Application Center (ALSA) developed a list of information quality criteria. This list (Figure 2) represents ALSA's recommendations for ensuring the decision-maker grasps the meaning of any information presented. Implementing the concepts of this list should negate the susceptibility of information to distortion, deception and confusion. This list also serves as an excellent guideline for identifying

meaningful formats for information presented with an Intranet-based decision support tool.

Accuracy
Information that conveys the true situation

Relevance
Information that applies to the mission, task, or situation at hand

Timeliness
Information that is available in time to make decisions

Usability
Information that is in common, easily understood format and displays

Completeness
All necessary information required by the decision-maker

Brevity
Information that has only the level of detail required

Security
Information that has been afforded adequate protection where required

Figure 2. Information quality criteria [Ref. 9, p. I-5]

3. Information Management

Equally important to the quality of information presented to the decision-maker is the concept of getting him the right information at the right time. A concept paper on command and control from the C4I division at Headquarters Marine Corps notes that information is passed under two basic principles: supply-push and demand-pull. [Ref. 9,

p. 64] A system that uses supply-push to provide decision support communicates the information as it is generated or on a set schedule. This provides the decision-maker with continuous access to the most current information as it becomes available. However, supply-push can lead to a situation of information overload for the decision-maker. Faced with too much information, the decision maker may miss the forest because of the trees. In some cases, the supply-push of information may actually inhibit good decision support.

In a demand-pull system, the information is stored and available to be presented when requested by the user. This allows the decision-maker to retrieve only the information needed to make a decision. Demand-pull should reduce information overload, but it carries the possible consequences of inadvertently withholding critical information from the decision-maker simply because the decision maker does not realize it is available.

Both demand-pull and supply-push offer desirable features. The C4I concept paper recommends developing information systems that are a hybrid of demand-pull and supply-push.[Ref. 9, p. 79] Web-based databases are an excellent solution since all of the critical information can be pushed to the database over the Intranet while the decision maker can pull information as required.

The focus of managing information for effective decision support must be on efficiently distributing information of high value to those who need it in a timely matter. Effective information management for decision support also means that the decision-

maker should not have to rely on specialized equipment or special operators to access the required information. Ideally, information should be made directly available to the decision-maker in a form that is easy to understand and work with. As an example, an image or graphical display provides the same information as a text-based list of data but presents it in a more meaningful form. [Ref. 9, p. 90]

4. Suitability For Intranet Migration

As part of the analysis phase of the SDLC methodology, requirements determinations and requirements structuring set the stage for developing Intranet-based decision support for the ACE. During this phase, process models (data flow diagrams) and data models (entity-relation diagrams) were developed to describe the information flows and information processes of the ACE (Appendix A). The results from this phase were used to identify the organization's information processes most suitable for migration to the Intranet. Suresh Sridhar [Ref. 11] developed a useful method of analyzing these results and established selection criteria to determine which information processes could be successfully migrated. Once all of the organization's key entities and processes have been determined and described by data flow diagrams, Sridhar recommends analyzing each information-based process for the following:

- Determine primary owner of information process
- Determine frequency of use (e.g., hourly, daily, weekly)
- Determine frequency of update

- Determine how the information is updated and used (e.g., single update/single query, multiple update/multiple query)

Having completed the process analysis (details provided in Appendix B), the next step is to apply Sridhar's selection criteria. This step involves choosing Intranet migration candidates from the organization's information processes. Migration candidates are those processes that belong to important owners, have high frequency of use, have a high update frequency and involve multiple updates/multiple queries. Once a process has been selected as an Intranet migration candidate it is assigned two values. The first value provides an assessment on a scale of 1 (poor) to 10 (excellent) of the expected impact of implementing the process on to the Intranet. The second value provides an assessment on a scale of 1 (long) to 10 (short) of how quickly the process could be developed for the Intranet.[Ref. 11] Annex C contains details on selecting the migration candidates. The results from this selection process were used to develop the prototype as described in Chapter IV.

5. Prototyping

Once the Intranet migration candidates were selected, the next step involved beginning work on a prototype. Prototyping enables the user to refine and adjust requirements without impacting the final product. According to John Rakos, Intranet-based decision support systems are ideal for prototyping because they are heavily dependent on the user's view of the system and require the user's input and output.[Ref. 12, p. 163] During prototyping for this project all, of the web-based menus, input forms,

output reports, query results and screen shots were made available to potential users for their comment and feedback. The prototype included a questionnaire that users could complete to provide their recommendations. These recommendations are included in Appendix D. As recommended by Rakos, this thesis project followed the steps of prototyping listed below:[Ref. 12, p. 162]

- Request and identify the user's initial requirements based on what the user thinks he needs.
- Build a prototype system to meet the initial requirements.
- Let the user play with prototype.
- Implement suggested changes.
- Let the user play with prototype until he is satisfied.
- Design and build the final system.

III. AVIATION COMBAT ELEMENT

A. INTRODUCTION

This chapter provides a brief overview of the ACE followed by a detailed analysis of the ACE organization. This analysis supports the third phase of the SDLC methodology used for this project. This chapter also provides an overview of the Air Tasking Order (ATO) process. Erik Jansen's work on the rational systems frame [Ref. 3] combined with Richard Burton and Borge Obel's work on the structural frame of reference [Ref. 13] provides the foundation for the organizational analysis of the ACE.

1. The ACE

The ACE provides air support to the Marine Air Ground Task Force (MAGTF) (Figure 3). The ACE performs the six functions of Marine aviation as required by the MAGTF commander. These six functions are offensive air support, assault support, air reconnaissance, electronic warfare, anti-air warfare, and control of aircraft and missiles. The ACE commander is responsible for optimizing the performance of the ACE to meet the MAGTF commander's guidance. The ACE commander uses the Air Tasking Order (ATO) to apportion and allocate the resources of the ACE in order to provide the required air support. The size and composition of the ACE varies depending on the mission of the MAGTF. A MEF-sized MAGTF would have a MAW serving as the ACE. A typical MAW has approximately four Marine Aircraft Groups (MAGs) composed of strike,

support or helicopter squadrons. A MAW would also have a Marine Air Control Group (MACG) and a Marine Wing Support Group (MWSG). Each Marine Group would be composed of several squadrons with similar missions.

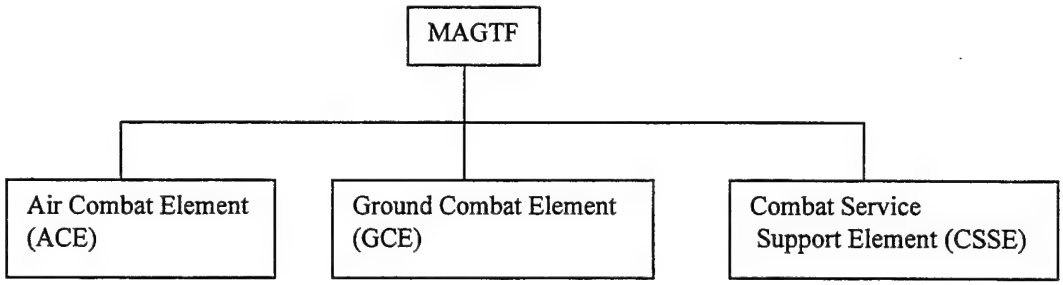


Figure 3. Marine Air Ground Task Force

2. The ATO

The ATO provides the tool the ACE commander uses to control his forces and provide air support to the MAGTF. If the MAGTF is part of a Joint Task Force (JTF), the ACE commander will coordinate with the Joint Force Air Component Commander (JFACC) to optimize air support to both the JTF and MAGTF. The JFACC or the ACE issues the ATO to control all of the air assets of the JTF or MAGTF. The USAF Battlestaff Training School released a multimedia CD-ROM that highlights the following key aspects of the ATO.

- An ATO permits centralized control and decentralized execution of air assets in the theater of operation. It is the JFACC's battle plan. The ATO normally lays out a 24-hour schedule of mission responsibilities for each air unit in the theater of operations. It establishes the number and types of aircraft, mission objectives and specific timing. [Ref. 14]

The full ATO planning cycle runs over a 72 hour period. Each ATO is a 24 hour schedule of air activities for all of the air assets from 0600 to 0559 the following day. Figure 4 is taken from the MEFEX1-97 training syllabus book and provides an example: on day D+1, ATO A is executed, ATO B is built, and ATO C is planned. On day D+2, the results of ATO A will be assessed, ATO B will be executed, ATO C will be built, and ATO D will be planned.

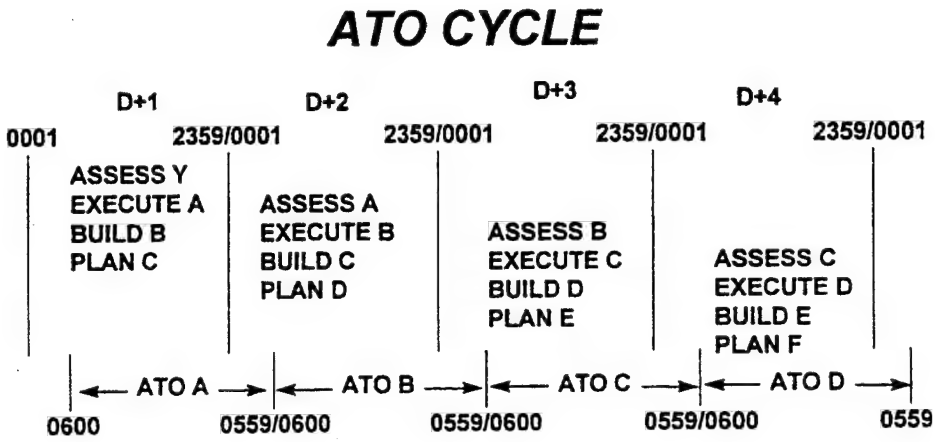


Figure 4. ATO cycle [Ref. 15, p. 13]

For the purposes of this project, the ATO hierarchy has been greatly simplified as depicted in Figure 5. Each ATO will be composed of multiple packages of different aircraft types that are grouped together to complete the specified tasking in the ATO. Each package is assigned a package commander. Packages are composed of several missions (e.g., offensive counter air (OCA), electronic combat (EC)) that will be operating together in the same area or providing support for each other during the ATO period. Each of these missions is composed of one or more sorties and each mission has

a mission commander. A sortie represents a single aircraft and the requisite aircrew for that aircraft. In Figure 5, PKG 1 is a strike package composed of MSN 1 which is an OCA mission and MSN 2 which is an EC mission. MSN 1 is further broken down into two sorties composed of F/A-18 aircraft with callsigns of Ghost 40 and Ghost 41. The package and mission commanders will be included in one of the sorties.

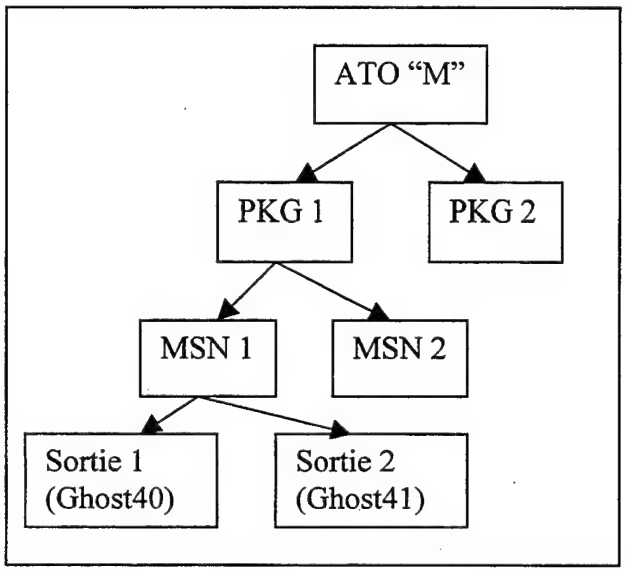


Figure 5. ATO mission structure

B. ANALYSIS OF THE ACE

An analysis of the ACE as an organization is the first step in determining the requirements for Intranet-based decision support for the ACE. The analysis starts with its operating environment and includes the mission and strategy, tasks and technologies, structure, and information and control systems of the ACE (Figure 6).

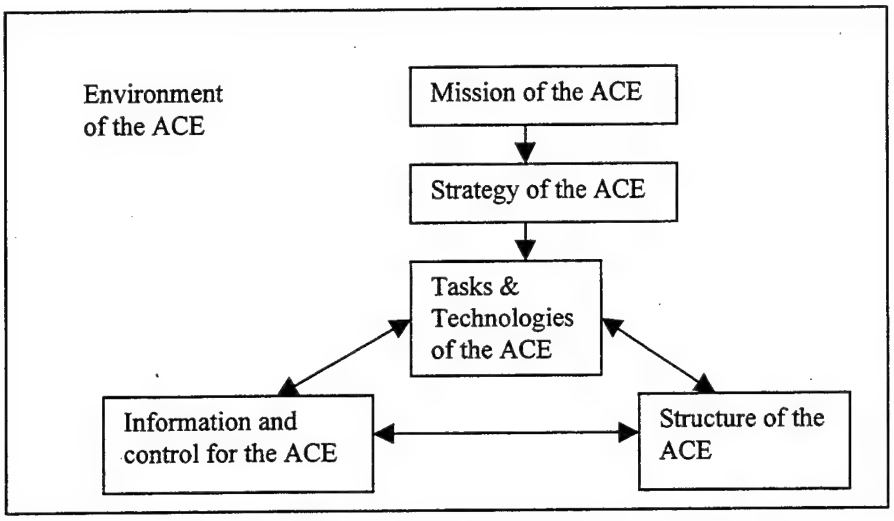


Figure 6. Rational systems frame for the ACE

1. Environment of the ACE

In an operational scenario, the ACE and its units will likely be scattered throughout the theater of operations and will operate in a complex, dynamic, high intensity environment. The ACE and MAGTF may be operating independently or in support of a JTF. As the operational scenario changes the ACE must be able to quickly and efficiently respond to the new environment. The distance between the ACE headquarters and the units of the ACE will stress the ACE battle staff's ability to coordinate with the ACE units. Similarly, the distance between the operational units of the ACE will hamper their ability to coordinate with each other. As with any military operation, the ACE's environment will certainly include the friction and fog of war that Clausewitz describes. To successfully operate in such an environment, the ACE must

achieve and maintain a level of situational awareness that allows the ACE to make the correct adjustments at the appropriate time.

2. Mission of the ACE

The mission of the ACE is to provide air support to the MAGTF commander. This air support may involve any or all of the six functions of Marine aviation described earlier.

3. Strategy of the ACE

In the rational systems frame, the strategy of an organization supports the mission of that organization. To accomplish the mission of providing air support to the MAGTF commander, the ACE commander develops an Air Battle Plan to control his assets. The Air Battle Plan is the ACE commander's battle plan. The process of producing an Air Battle Plan to provide air support to the MAGTF serves as the strategy of the ACE.

4. Tasks of the ACE

To properly support its strategy of producing an Air Battle Plan, the ACE must develop the Air Tasking Order (ATO) which tasks aviation units to perform specific missions, and the Airspace Control Order which defines the airspace for the ATO. [Ref. 16, p. 49] Developing the ATO involves numerous sub-tasks which are discussed below and in Appendix A.

a. Develop ACE support plan

The first task of the ACE battle staff is to develop the ACE support plan for future ACE operations. This task requires access to the current and forecast status of both enemy and friendly forces. The task also requires guidance from the both the ACE and MAGTF commanders on their objectives for future operations. The ACE Future Plans Directorate analyzes this information and develops several courses of action (COAs) to present to the ACE commander. Once the ACE commander selects a COA, the Future Plans Directorates builds the ACE support plan for future ACE operations. This process eventually leads to the development of future ATOs.

b. Determine status of warfighting resources

This task involves maintaining the status of all the ACE's warfighting resources. Warfighting resources include airfields, aircraft, equipment, spare parts, consumable goods such as fuel and ordnance, and personnel. To develop an ATO that optimizes available resources, the ACE battle staff requires continuous updates from all of the units of the ACE who maintain these warfighting resources. Since the units of the ACE manage the assets and resources the ACE needs to complete its mission of providing air support to the MAGTF, they will be labeled as Resource Managers for this analysis.

The task of determining the status of warfighting resources involves several implicit sub-tasks for the ACE Resource Managers. Depending on the type of

resource they are responsible for, each Resource Manager must be able to provide the appropriate information in a timely manner to the ACE battle staff. Examples of sub-tasks include:

- Determining aircraft and aircrew availability by squadron and projecting the number of sorties each squadron can provide for future operations.
- Maintaining the current ACE force list and force laydown.
- Determining the amount of each type of critical resource available at each airfield and computing the projected expenditure rate of the critical resource.

c. Develop next ATO

Once the ACE Future Operations Directorate receives the ACE support plan for future operations from the Future Plans Directorate it can began developing the next ATO. This task also involves the following sub-tasks.

- Updated guidance from the ACE and MAGTF commanders are analyzed and applied to the next ATO.
- Previous ATO results are analyzed and the lessons learned are applied to the next ATO.
- The latest intelligence information on the threat forces and the status of forces for the ACE are analyzed and applied to the next ATO.

Once the next ATO is developed, the Future Operations Directorate disseminates the ATO to the ACE Resource Managers to allow them to prepare for their role in the next ATO.

d. Execute the current ATO

After the next ATO is disseminated and all preparations are completed, the Current Operations Directorate assumes the responsibility for coordinating the execution of the ATO. This task involves several sub-tasks as well.

- The status of forces of the ACE must be reviewed to insure sufficient numbers of the proper resources are available to execute the ATO
- Updated guidance from the ACE and MAGTF commanders are incorporated into the ATO execution process. These could include changes to standard operating procedures or adjustments to the rules of engagement.
- The threat situation is continuously reviewed to minimize high threat situations and maximize opportunities.
- The status of ATO assigned targets are monitored and target assignments are adjusted as necessary.
- The ACE Resource Managers and the Current Operations Directorate coordinate the flow of information to optimize the situational awareness of the entire ACE.

e. Assess ATO results

Even as the current ATO is being executed, the task of analyzing its results is already underway. Changes to threat information and target status are updated as ATO missions report back with their success or failure. The ACE status of forces is continuously updated with information about the expenditure of ordnance and consumables, as well as the status of aircraft, aircrew, and special equipment. Once the ACE Resource Managers determine the status of their resources they report the information back to the ACE battle staff. The ACE and MAGTF commanders are briefed

on the success or failures of the ATO. As ATO missions return, the lessons learned from the ATO participants are collected and made available to the Future Plans Directorate as they begin development on the next ATO.

5. Structure of the ACE

Using the terms provided by Henry Mintzberg's model for organizational analysis, both the MAGTF and the ACE are hierarchical, machine bureaucracies. [Ref. 17, p. 338-39] In order to coordinate the complex air battle plan contained in the ATO, the ACE must operate with a centralized control and decentralized execution. The ACE incorporates standard operating procedures developed during training and rehearsals to reduce the uncertainty expected during actual operations. As the strategic apex, the ACE commander provides his commander's intent to his forces. The ACE forces rely on their training and standard operating procedures to accomplish their objectives. Figure 7 shows the ACE structure.

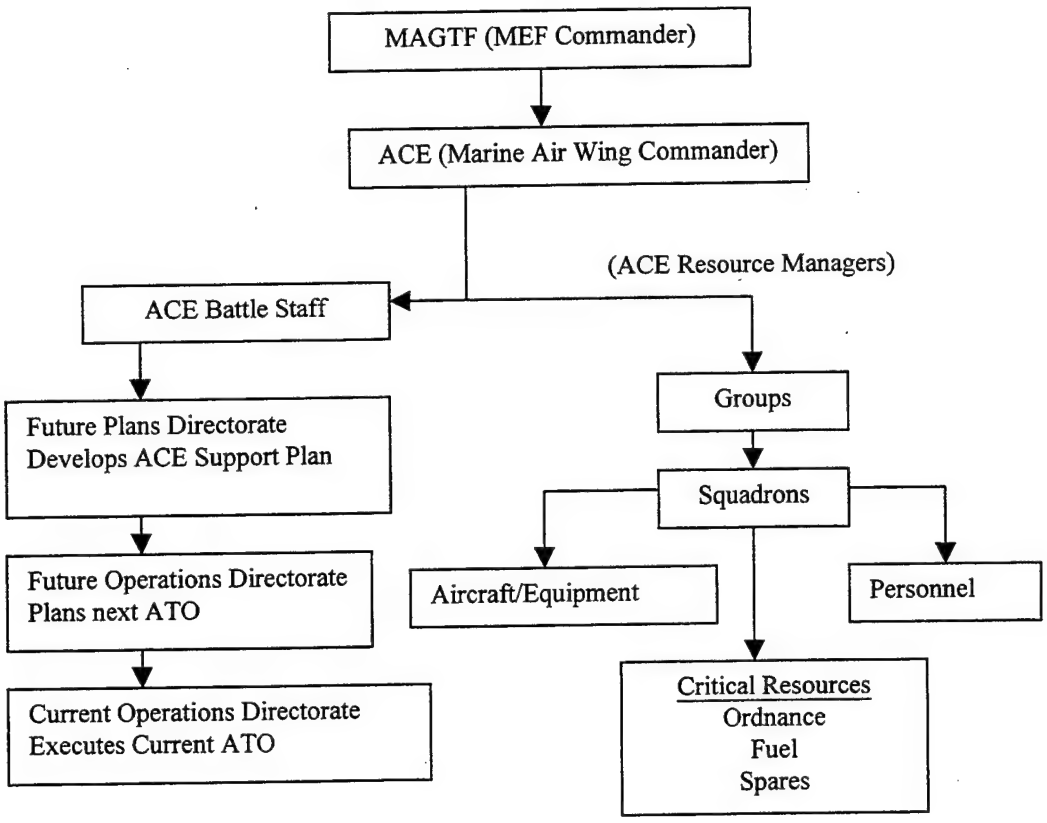


Figure 7. ACE Structure

During the planning and execution of the ATO, the various groups involved on an ATO mission function as a professional bureaucracy with strong cohesiveness and decentralized management. The personnel responsible for executing the missions of the ATO share a standardization of skills which enhances their coordination during the mission. This standardization of skills within their professional bureaucracy enables operator success despite the physical separation of the ACE units on the ground. Even without face-to-face coordination prior to the missions, the complexity of executing the ATO is dampened by the specialized and standardized skills of the aircrew and special

equipment operators. Because of the extensive training and standardization of the professional bureaucracies, the volume of information that needs to be exchanged prior to the mission can be significantly reduced to only that information that improves situational awareness and mission coordination.

6. Information and control for the ACE

While the development of the ATO serves as the strategy of the ACE to meet its mission, the ATO itself provides one of the primary sources of information and control within the ACE. Every resource manager, mission planner, and tactical operator relies on the information in the ATO to plan, prepare, and execute assigned ATO tasks. However, the ATO does not support every aspect of the information and control required by the ACE. Because the ACE will likely be spread out over several airfields in the theater of operations, the ACE battle staff and ACE units rely on message traffic, email, secure and clear telephones, fax machines, and couriers to enable the various parts of the ACE to cross coordinate. When the ACE battle staff develops and executes the ATO they ensure proper vertical integration. However, to truly optimize its performance in the complex air battle plan, the ACE hierarchy must practice good horizontal integration as well. The ACE relies on several C4I systems linked together on a secure network (secret internet protocol network or SIPRNET) to support information and control for both vertical and horizontal integration. These systems are described below.

a. Contingency Theater Automated Planning System (CTAPS)

CTAPS is an U.S. Air Force designed system that represents a collection of several systems and applications under one program for the purpose of automating the ATO process. Included under the CTAPS umbrella are applications such as Rapid Application of Air Power (RAAP) for target development, Advanced Planning System (APS) which supports air battle planning and ATO production, Airspace Deconfliction System (ADS) which supports airspace planning and management, and Computer Assisted Force Management System (CAFMS) which supports ATO dissemination and ATO execution and monitoring. CTAPS is a Sun SPARC based client-server system that pulls ATO information from Oracle and Sybase relational databases and presents it to the user. CTAPS is networked on the SIPRNET to enable the entire ACE to share information. A few properly trained CTAPS operators can develop the entire ATO for the ACE in a relatively short period of time. CTAPS is the primary system for developing ATOs in a joint environment. CTAPS will eventually be replaced by the Theater Battle Management Core System (TBMCS).[Ref. 18]

The Future Operations Directorate utilizes CTAPS to develop the next ATO based on the guidance received from the ACE commander and the ACE support plan provided by the Future Plans Directorate.

During MEFEX, the author observed that the ATO planners in the Future Plans Directorate, who were composed of aviators from all communities, did not actually use the CTAPS as designed. All of their planning was accomplished on pencil and paper.

After they were finished, their planning documentation was submitted to enlisted CTAPS operators who entered the data into CTAPS. This procedure appears to result from a lack of CTAPS training for Marine aviators. The aviators did not understand what the system could do and felt more comfortable working their problems out by hand.

Once the ATO is published, it is electronically distributed throughout the ACE to everyone who has access to a CTAPS machine. Currently, CTAPS is not usually found below the Marine Air Group level, so most squadrons receive a hard copy of the ATO from the Marine Air Group. The Current Operations Directorate relies heavily on the information within CTAPS as it executes the current ATO. The information in CTAPS is updated by voice reports, phone calls, messages, and emails from the various ACE units as the ATO is executed. [Ref. 16, p. 50]

b. Intelligence Analysis System (IAS)

IAS is a Marine Corps designed, Sun SPARC-based client-server system that will also be attached to the ACE's SIPRNET and will provide users with the capability to view filtered and fused intelligence information collected from MAGTF and other intelligence agencies.[Ref. 19]

c. Tactical Automated Mission Planning System (TAMPS)

TAMPS is an U.S. Navy designed Sun SPARC-based system that provides the aviators and mission planners with the tools required to plan specific air missions. TAMPS is found at the squadron level and group level. Each TAMPS machine is

currently a stand alone unit and not attached to the SIPRNET. Plans are underway to migrate TAMPS functionality to an NT Server platform. This plan will support networked databases and allow integrated mission planning between units.[Ref. 20]

d. Tactical Combat Operations (TCO) system

TCO is a Marine Corps designed system that is currently Unix-based but will be migrating to Windows NT laptops. TCO provides displays showing the position and strength of friendly and enemy forces. TCO also supports the display of overlays to show future actions and planned movements of friendly ground forces. TCO provides the ACE with the best picture and situational awareness of the current ground situation. TCO is attached to the ACE SIPRNET and will be employed down to the Marine Group level.[Ref. 21]

e. Global Command and Control System (GCCS)

GCCS is a jointly developed, Unix-based client-server system attached to the SIPRNET. GCCS includes several applications used in planning and executing joint operations. GCCS will normally only be found at the ACE level.[Ref. 22]

f. Advanced Field Artillery Tactical Data System (AFATDS)

AFATDS is an U. S. Army designed system that automates the fires support process for the ACE by filtering the targets and matching targets with available

fire support systems. AFATDS will be attached to the MAGTF SIPRNET and will likely be found only at the ACE level.[Ref. 23]

g. Example of ACE architecture

The following figures show the architecture for the ACE command and control structure used during MEFEX. Figure 8 is the Future Plans Directorate, Figure 9 is the Future Operations Directorate and Figure 10 is the Current Operations Directorate. [MEFEX] The SIPRNET-linked C4I systems described above and the architecture depicted below serve as the network foundation for developing an ACE Intranet-based decision support tool.

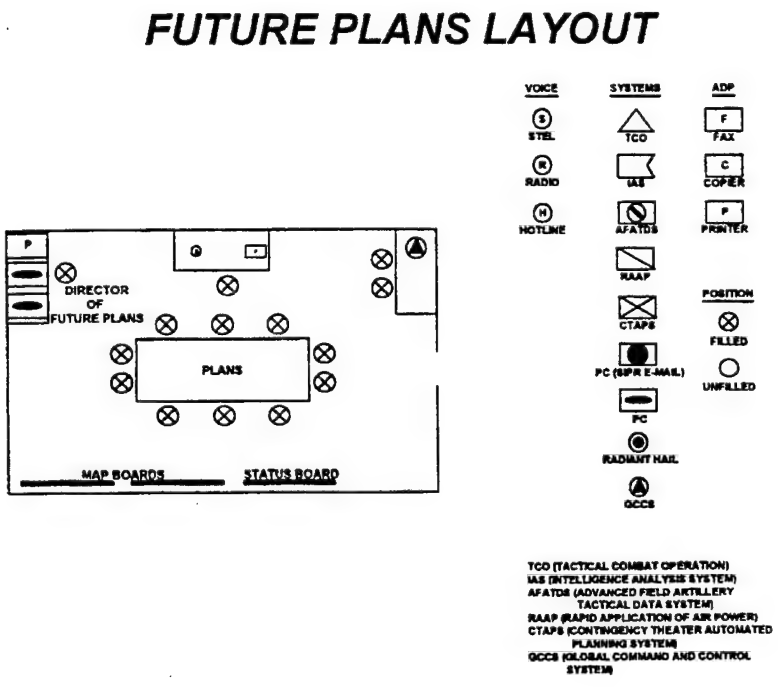


Figure 8. Future Plans Layout [Ref. 15]

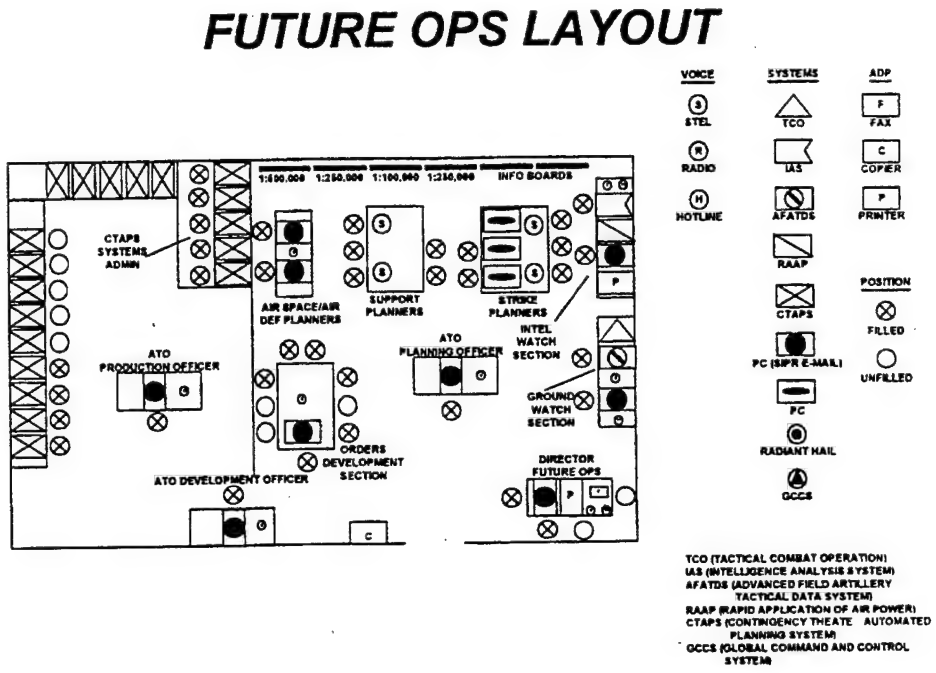


Figure 9. Future Operations Layout [Ref. 15]

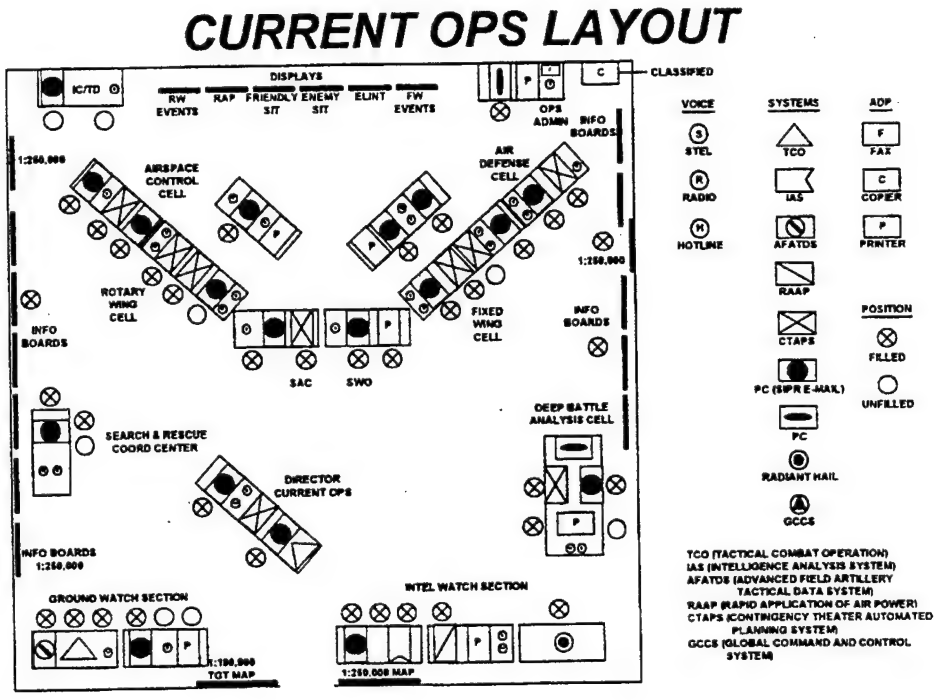


Figure 10. Current Operations Layout [Ref. 15]

IV. DEVELOPING THE PROTOTYPE

A. INTRODUCTION

As discussed earlier, this thesis followed the SDLC and prototyping methodologies. The first two phases of the SDLC, project identification and project initiation were completed in the spring of 1997. The analysis phase started with two trips to the Third Marine Aircraft Wing (3rd MAW) during June and July 1997. Data collection during these trips included observing operations and procedures during the MEFEX 1-97 and discussions with key personnel. Marine Corps documents and doctrinal publications explaining the functions of an ACE and the ATO processes were reviewed in detail and provided a large share of the information needed for requirements determination. [Refs. 24 through 30]

From August to December 1997, the author utilized the 3rd MAW documents, doctrinal publications, and his own operational experience to develop an understanding of the requirements for implementing Intranet-based decision support for the ACE. As part of structuring these requirements, data flow diagrams were developed to model the processes of the ACE. Also, as part of structuring the requirements, entity-relationship diagrams were developed to support conceptual data modeling. These entity-relationship diagrams were converted into Microsoft Access tables with the appropriate relationships.

After completing the requirements structuring, the objectives and methodologies of Intranet-based decision support were applied to the process and data models. The final

result of the analysis phase identified ACE processes that satisfied the objectives of Intranet-based decision support and were suitable for migration to an Intranet-based format. Work on the analysis phase ended in December 1997.

Those processes selected for migration then moved to the logical design phase and were incorporated into the prototype. This phase started in January and the prototype was finished in March 1998. This phase involved developing Intranet-based forms, reports, dialogues and interfaces to provide decision support for the ACE. As part of the prototype process, input from fleet operators was sought and incorporated into the prototype throughout the logical design phase.

The prototype is called the ACE ATO Support System and is composed of a Microsoft Access database and approximately 100 Cold Fusion-based files for the individual web pages. Using the Cold Fusion application server, the ACE ATO Support System dynamically generates web pages populated with information from the database based on the inputs of the user. To demonstrate the functionality, scalability and flexibility of the prototype, the database for the prototype contains realistic but fictional information from several varieties of Marine Corps aircraft squadrons. The database contains detailed information on seven squadrons with approximately ten aircraft and twenty fictional aircrew per squadron. The database also contains missions and sorties for three ATO periods which equals approximately 300 sorties. The database also has realistic but fictional information on critical resources and special equipment that would be maintained and operated by the ACE.

This chapter explains individual ACE process requirements and discusses the process and data models that describe the requirement. This chapter also shows examples from the ACE ATO Support System prototype that were developed based on the process and data models. The prototype examples represent the end result of applying the objectives and methodologies of Intranet-based decision support. Along with the examples are recommended implementation procedures for the ACE ATO Support System.

For the purposes of this project, the majority of the ACE processes fall under two broad categories: processes that support determination of the "status of forces" for the ACE, and processes related to planning for and executing the ATO.

1. ACE "Status Of Forces" Processes

Collectively, the processes that fall under the label of "status of forces" provide support to the ACE battle staff and the ACE resource managers. These "status of forces" processes enable the ACE battle staff and ACE resource managers to manage their assets. For the purposes of this thesis, these assets include aircraft, personnel, special equipment, airfields and ordnance. To successfully operate in the dynamic environment of the ACE, the ACE battle staff and the ACE resource managers must have continuous access to accurate and concise information on the availability and status of assets.

2. ATO Related Processes

These processes provide information to the ACE battle staff and the resource managers on the status of the ATO. As with the "status of forces" processes, the ATO related processes are of vital importance to all and require accurate and concise displays of relevant information. ATO information includes the status of the current ATO as it is being executed, as well as the results of the previous ATO to provide opportunities for learning from previous ATO successes and failures. The ATO processes were added to the prototype after the requirements structuring had been completed. Therefore, there are no data flow diagrams for many of the ATO processes.

B. EXAMPLES OF STATUS OF FORCES PROCESSES

1. Process - Determine ACE Force List/Force Laydown

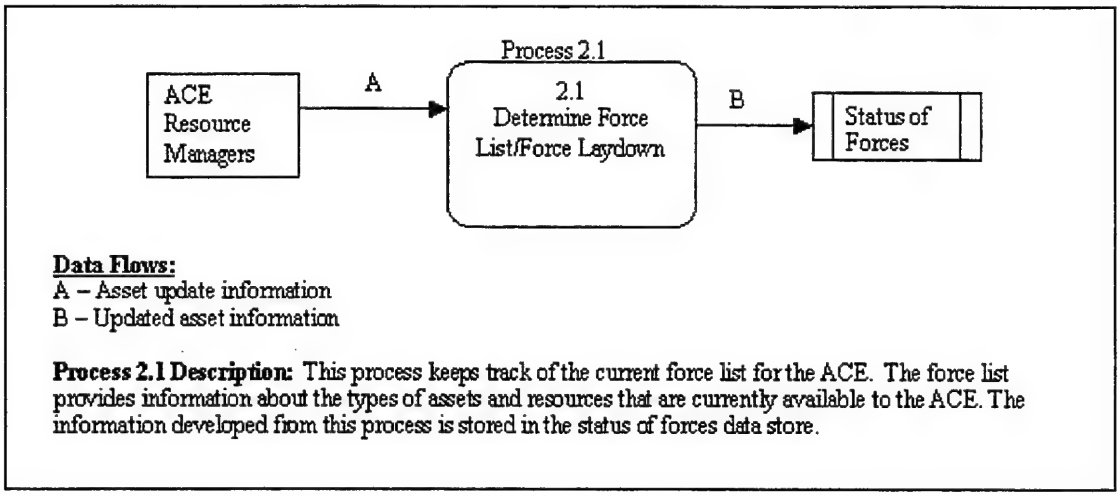
The ACE Force List/Force Laydown process maintains current information on the location and strength of units attached to the ACE. The ACE battle staff is responsible for managing this process. Currently the information is normally posted on a wall chart in the ACE battle staff working area. The ACE resource managers provide the ACE battle staff with the required information whenever there is a change. Updates to the Force List are communicated over the phone, through email, or through message traffic. This information will not change too often, however the information will be viewed on a daily basis by the ACE battle staff.

a. Requirements and critical success factors

Depending on the size and objectives of the MAGTF and ACE , the ACE could be composed of dozens of units scattered at several locations in the theater of operations. The ACE commander, his battle staff, and the resource managers must have continuous access to accurate information that displays the location and strength of all of the ACE units. This information should be readily available for any interested user at any time. Updates to this process should be posted for all users to view as soon as changes are made. Any changes to the Force List/Force Laydown should immediately be updated and available for viewing. This information should also be presented in an easily understood and meaningful format.

b. Process and data models

The primary entities for this process are the bases, units, aircraft, aircrew, special equipment and resources managed by the ACE resource managers. This process keeps track of the location and status of all of these entities. Figure 11 shows the data flow diagram for this process, and Figure 12 shows the relations between the tables for the entities associated with the Force List/Force Laydown process.



Data Flows:
A – Asset update information
B – Updated asset information

Process 2.1 Description: This process keeps track of the current force list for the ACE. The force list provides information about the types of assets and resources that are currently available to the ACE. The information developed from this process is stored in the status of forces data store.

Figure 11. Force List DFD

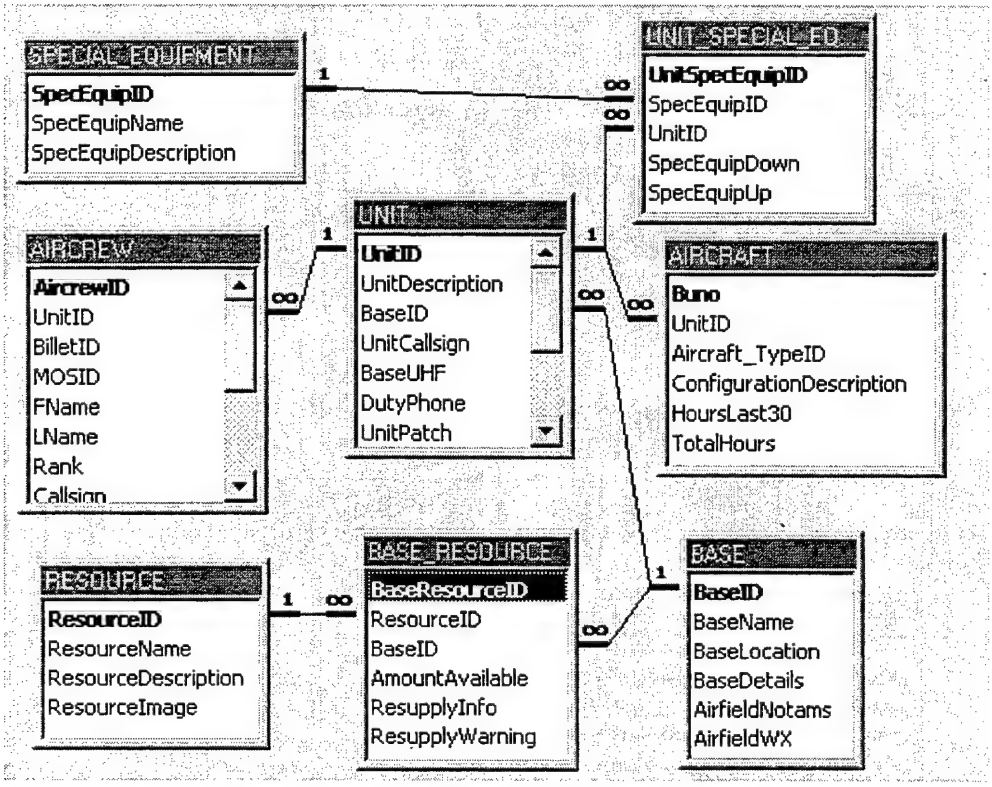


Figure 12. Force List table relationships

c. Prototype displays and dialogue

In order to meet the requirements and critical success factors for the Force List/Force Laydown process, the prototype implemented the technique of "data drill down". The initial display of information (Figure 13) provides the user with a big picture view of the information about the location and strengths of the various units in the ACE. All of the units at each airfield are listed as well as the total number of aircraft for each unit. The total number of aircraft in the ACE is available at the top. By selecting one of the units, the user can view additional information about the specific unit.

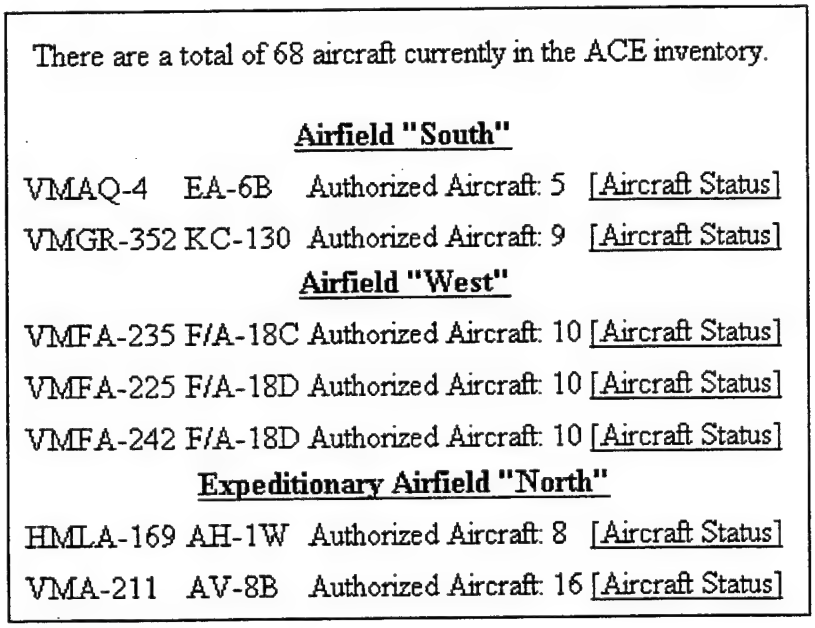


Figure 13. Force List web page

d. Implementation procedures

Each individual unit or squadron would be responsible for maintaining its own information in the ACE ATO Support System database. As the status of a squadron changes, select individuals from the squadron would update the database information for the Force List using separate web pages that will be discussed later. Through the use of security measures that will also be discussed later, a squadron would only be able to update its own information, but all users would be able to view all information on the Force List/Force Laydown web page.

e. Interoperability issues

Incorporating this process as an Intranet-based decision support function for the ACE should improve the flow of information and interoperability within the ACE as required to maintain the status of the Force List/Force Laydown. Units will be relieved of their responsibility of phoning in or emailing changes, and instead can directly update the ACE ATO Support System database themselves. The ACE battle staff will no longer have to dedicate the manpower and resources to maintain this information since the units will be maintaining the information themselves.

2. Process – Determine Aircraft Availability By Squadron

The ACE battle staff is the primary user of this process. Currently, each of the squadrons is responsible for providing the ACE battle staff with updated information on the status of its aircraft. This information is communicated to the ACE with phone calls,

email and message traffic. ACE battle staff personnel collect the information and display it on a wall chart in the ACE battle staff working area. This information changes frequently and is viewed by many different users.

a. Requirements and critical success factors

In order to conduct planning for future ATO's, the ACE battle staff requires easy access to the status of all aircraft in the ACE. This information should be presented in a user friendly format and should be easily and quickly updated to reflect the latest information. The status of aircraft will change as aircraft break, receive battle damage, or need time for periodic maintenance. This process determines periods of aircraft nonavailability and presents that information to those who need it.

b. Process and data models

This process relies on the Resource Managers (squadrons) to keep track of their individual aircraft. The entities for this process include the unit and the base where the unit is located, the type of aircraft operated by the unit, each specific aircraft operated by the unit, and the status of each aircraft. Figure 14 is the data flow diagram for aircraft availability, and Figure 15 shows the relations between tables for these entities.

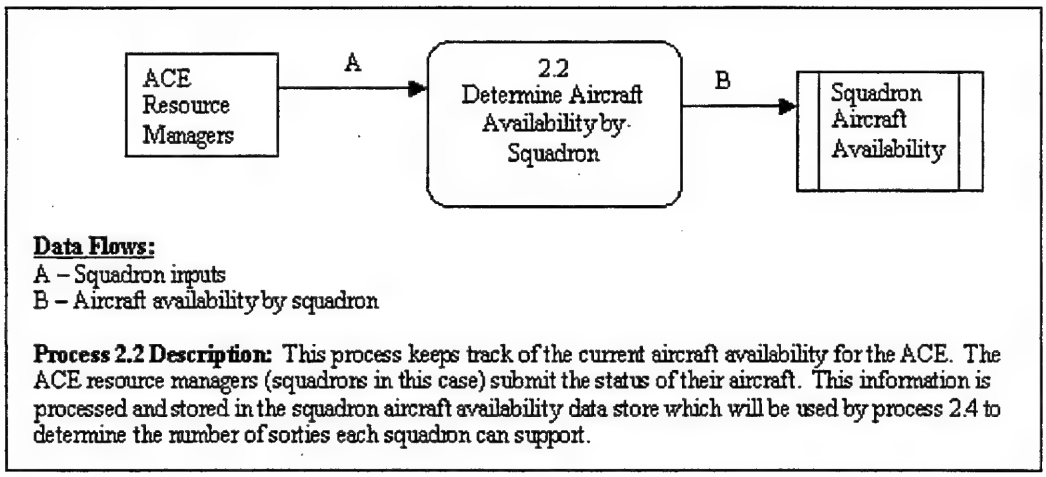


Figure 14. Aircraft availability

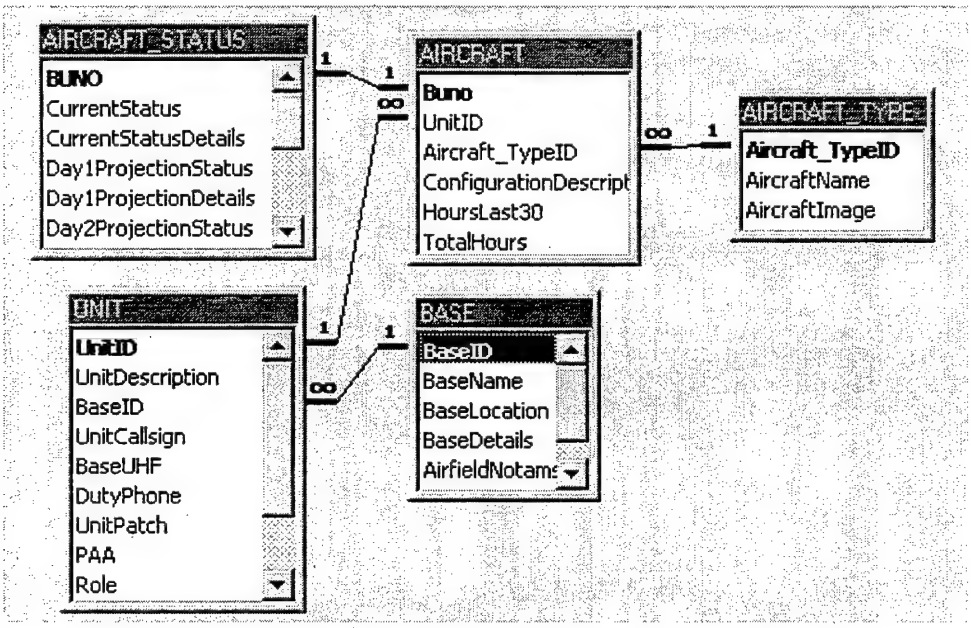


Figure 15. Aircraft availability table relationships

c. Prototype displays and dialogue

The ACE ATO Support System allows the user to select a specific squadron to view the aircraft availability information for that squadron. The initial screen for the

squadron's aircraft (top part of Figure 16) shows all of the aircraft belonging to the squadron and their current and projected status. The projected status is based on the squadron's expected availability out to ten days in the future. Aircraft projected to be in a "down status" are highlighted in yellow to catch the user's immediate attention. This information provides the ATO battle staff with the decision support required to estimate how many aircraft they can plan on having for future operations. By selecting the bureau number of an aircraft, the user can find additional information for that aircraft including reasons for its nonavailability and its total flight time and a description of any special configurations for the aircraft (bottom part of Figure 16).

There are a total of 5 aircraft currently assigned to VMAQ-4.

VMAQ-4 EA-6B status projections

Aircraft	Current (Apr 21)	1 Day (Apr 22)	2 Day (Apr 23)	3 Day (Apr 24)	5 Day (Apr 26)	10 Day (May 01)
159030	Down	UP	UP	Up	Up	UP
159031	Up	UP	UP	Up	Up	UP
159032	Down	UP	Up	Down	Down	UP

Details on EA-6B - 159032 assigned to VMAQ-4.

View and update information on 159032

Aircraft Details	Flight Hours (last 30 days)	Total Hours
Equipped with Band 10 receiver	36	4785

5 Day Projected Status is: Down Details

Change status to: Down

Maintenance Phase

Figure 16. Aircraft web page

d. Implementation procedures

Each individual unit or squadron would be responsible for maintaining the information on its aircraft in the ACE ATO Support System database. As the status of a squadron's aircraft changes, select individuals from each squadron would update the database information for aircraft availability using the displays shown above. Squadrons would only be able to update information on their own aircraft, but all users would be able to view the current and projected status of each aircraft at all times.

e. Interoperability issues

This process should improve the flow of information and interoperability required for decision support to the ACE battle staff as they monitor the status of squadron aircraft. Individual units will simply update the information directly into the ACE ATO Support System and will no longer be required to provide daily status reports to the ACE headquarters. The ACE battle staff will no longer have to dedicate the manpower and resources currently required to maintain this information since it will be done directly by the units and individuals with the best information.

3. Process – Determine Aircrew Availability By Squadron

The ACE battle staff is the primary user of this process. Currently, each of the squadrons is responsible for providing current information on the status of its aircrew to the ACE battle staff. This information is communicated to the ACE with phone calls, email and message traffic. ACE battle staff personnel collect the information and display

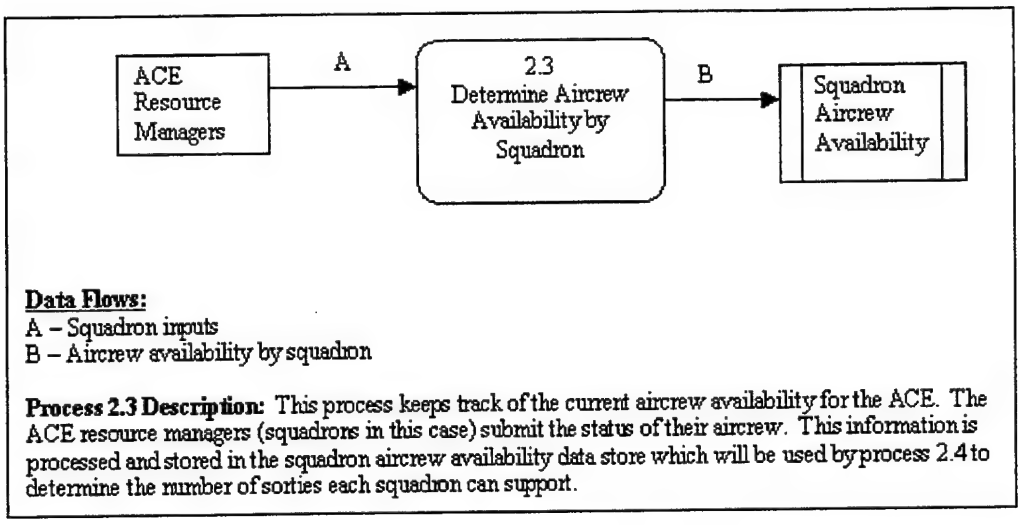
it on a wall chart in the ACE battle staff working area. This information changes frequently and is viewed by many different users. However, the current information provides few additional details other than the total number of aircrew available for each squadron

a. Requirements and critical success factors

Each of the squadrons in the ACE will have aircrew assigned to fly its aircraft. Similar to aircraft availability, the ACE battle staff will need to know how many aircrew will be available in the future for each squadron in order to plan future ATOs. This information must be presented in a user friendly format that can be quickly and reliably maintained. As the status of the aircrew change, the information must be updated and made available for all users to view. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the amount of information required for the selected aircrew.

b. Process and data models

This process relies on the squadrons (resource managers) to keep track of their aircrew. The entities for this process include the unit, the aircrew attached to the unit, the billets and qualifications of the aircrew, and the status of the aircrew. Figure 17 is the data flow diagram for aircrew availability and Figure 18 shows the relations between the tables for these entities.



Data Flows:
A – Squadron inputs
B – Aircrew availability by squadron

Process 2.3 Description: This process keeps track of the current aircrew availability for the ACE. The ACE resource managers (squadrons in this case) submit the status of their aircrew. This information is processed and stored in the squadron aircrew availability data store which will be used by process 2.4 to determine the number of sorties each squadron can support.

Figure 17. Aircrew availability DFD

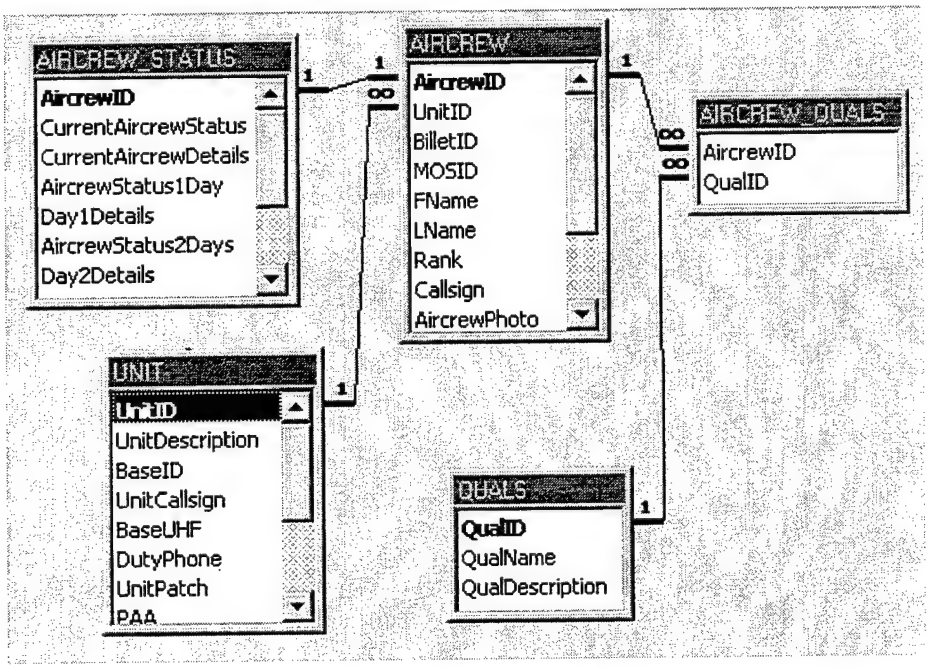


Figure 18. Aircrew table relationships

c. Prototype displays and dialogue

The ACE ATO Support System uses dynamically generated web pages to display all of the aircrew for any squadron. As shown in Figure 19, the user selects a squadron to view the all of the squadron's assigned aircrew. By selecting an individual aircrew, the user can drill down into the aircrew's data to find additional useful information for decision support. As with the aircraft page, the aircrew page shows the current and projected availability for each aircrew out to five days in the future. Aircrew projected to be unavailable on any day in the future will show a "No" highlighted in yellow to catch the user's immediate attention. Selecting an aircrew and drilling down allows the user to view information on billet held, email, phone, a picture of the aircrew (not shown), and current hours for the aircrew.

Expeditionary Airfield "North"

HMLA-169 AH-1W [Aircrew Status]

1. Select squadron

20 pilots assigned.

Availability of Aircrew assigned to HMLA-169

7565	Today	Apr 24	Apr 25	Apr 26	Apr 28
Maj Beatty	Yes	No	No	Yes	Yes
Capt Cheatham	Yes	Yes	Yes	Yes	Yes
Capt Condon	Yes	Yes	Yes	Yes	Yes
Capt Connally	Yes	Yes	Yes	Yes	Yes

2. Select specific aircrew to review aircrew info

Current Billet	MOS	Flight Hours (last 30 days)	Total Hours	phone	email
Aircrew Training	7565	21	362		

Qualifications currently held by Capt Connally [Update Quals]

ASO

HAC

Mission Commander

Figure 19. Aircrew web pages

d. Implementation procedures

Each squadron would be responsible for maintaining the information on its aircrew in the ACE ATO Support System database. As the status of an aircrew changes, select individuals from each squadron would update the database information using web-based forms in the ACE ATO Support System (forms not shown). Squadrons would only be able to update information on their own aircrew, but the aircrew status information would be available for anyone with access to the ACE ATO Support System to view.

e. Interoperability issues

By dynamically generating the display showing the status of squadron aircrew, this process should improve the flow of information and interoperability required for ACE decision support. Individual units will no longer be required to provide daily status reports to the ACE headquarters. The ACE battle staff will no longer have to dedicate the manpower and resources currently required to maintain this information since it will be done directly by the units and individuals with the best information.

4. Process – Compute squadron projected sortie availability

Currently, the ACE battle staff tracks this process through the use of information passed from the resource managers describing the squadron aircrew and aircraft availability. This information is manually entered into a spreadsheet-style form. Members of the ACE battle staff then manually calculate the projected sortie availability for the ACE. The ACE battle staff transforms this information into knowledge leading to

a better understanding of the constraints in developing future ATOs. However, the current process is time consuming and requires a great deal of coordination between the resource managers and ACE battle staff through email, phone calls and message traffic to keep the information current.

a. Requirements and critical success factors

In order to plan the number of sorties that will be available for future ATOs, the ACE battle staff must be able to project the number of aircraft and aircrew each squadron will have. By providing the battle staff with a big picture snapshot of the status of each squadron's aircraft and the sortie history of the squadron, the battle staff can develop a solid plan based on realistic data. The projected sortie availability reflects the most current status of all aircraft, and applies a standard value for sustained and surge sortie rates for each type of squadron that the squadron will have in an "Up" status. The traditional method of calculating future sortie availability by multiplying the number of aircraft assigned by a standard value of 0.85 for fixed wing or 0.80 for helicopters is still calculated for comparison.

b. Process and data models

This process relies on the squadrons to maintain the status of their aircraft, aircrew and sortie rate history. The entities for this process include the unit, the aircraft and aircrew belonging to the unit, the aircraft status, and the squadron's sortie rate history. Figure 20 is the data flow diagram for this process and Figure 21 shows the relationships between the tables for these entities.

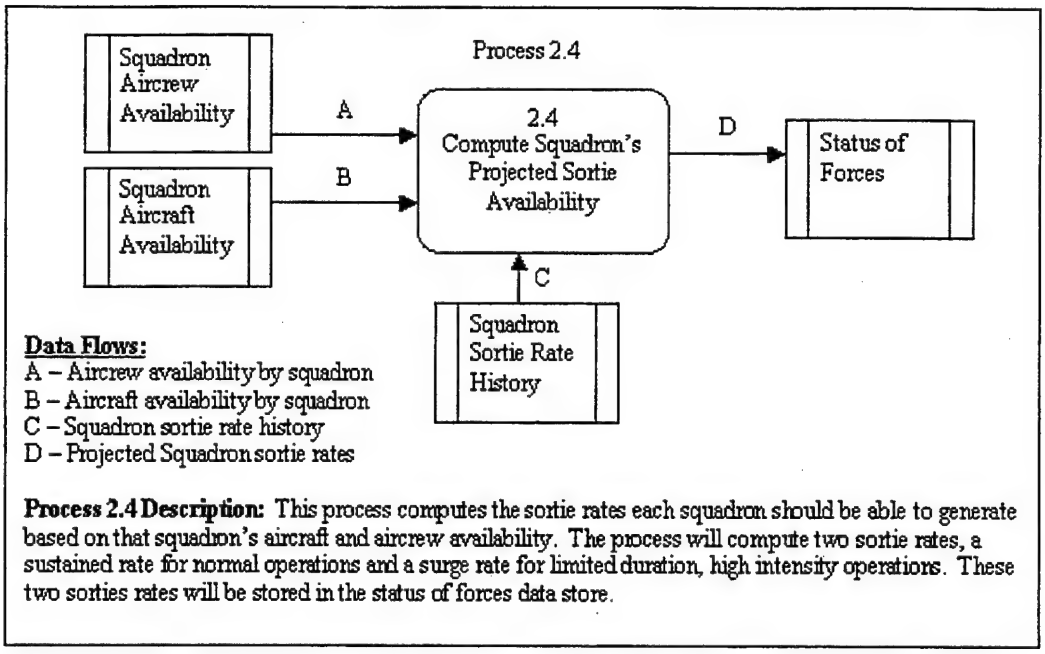


Figure 20. Projected sorties DFD

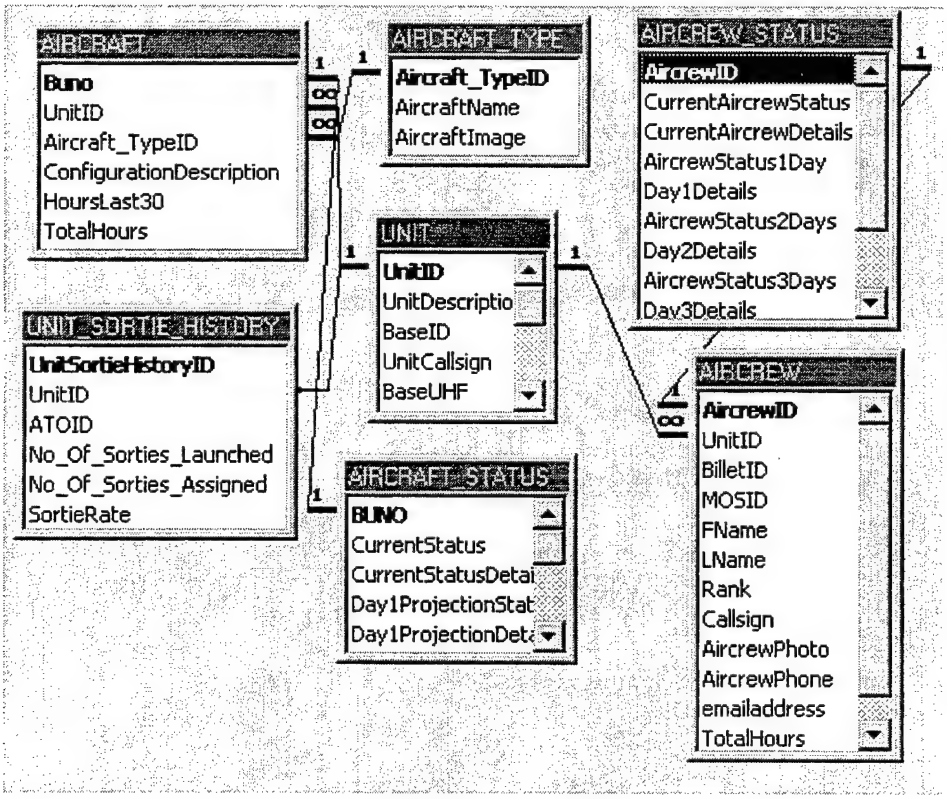


Figure 21. Projected Sortie Relationships

c. Prototype displays and dialogue

The ACE ATO Support System allows the user to select a specific squadron to view the projected sorties. The prototype dynamically generates a display that provides the decision-maker with relevant information that can be used for decision support in determining the projected number of sorties. The display, as shown in Figure 22, lists the projected aircrew and aircraft availability over the next few days. By selecting the aircraft or aircrew links, the user has access to the aircraft and aircrew availability pages described above. From these pages the user can quickly view more detailed information on the status of any particular aircraft or aircrew. The display in Figure 22 also performs two calculations to provide the decision-maker with additional information to increase his understanding before making a decision. The first calculation simply takes the number of aircraft the squadron owns multiplied by a standard availability value for fixed wing (0.85) or rotary wing (0.80) squadrons and by the values for the assigned surge (4.0) and sustained rates (2.5).[Ref. 15] The result is the number of sorties a squadron should be able to generate.

(Total number of aircraft) x (0.85 for fixed wing) x (surge rate) = sorties

The second calculation was developed as part of this thesis and incorporates the information stored in the database. This calculation provides the decision maker with a projected sortie rate based on availability data from the database. The calculation uses the number of squadron aircraft projected to be in an "Up" status on any given day multiplied by the values for assigned surge and sustained rates.

(Number of "Up" aircraft) x (surge rate) = sorties

Although it is not shown below, this web page also displays the number of sorties the squadron generated during previous ATO cycles. This information provides the decision maker with an understanding of how hard the squadron has been working and how well it is meeting its assigned tasks.

	Today (Apr 23)	1day (Apr 24)	2days (Apr 25)
Pilot availability	10	10	9
NFO availability	10	10	10
Aircraft availability	9	8	7
Projected sorties (Sustained/Surge) based on 10 aircraft and FMC factor of 0.85		(21/34)	(21/34)
Projected sorties (Sustained/Surge) based only on projected aircraft availability		(20/32)	(17/28)
Sustained Rate = No more than 2.5 sorties per day per aircraft			
Surge Rate = 4 sorties per day per aircraft			

Figure 22. Sortie availability web page

d. Implementation procedures

Specific individuals in each squadron's department would be responsible for monitoring the information for this process. Since the process requires no additional information other than what must be entered for the aircrew and aircraft availability processes described above, projected sortie calculations are available to be "pulled" by the decision-makers as needed.

e. Interoperability issues

By implementing this process on the web, the decision-makers on the ACE battle staff will have access to Intranet-based decision support that they can pull as needed. The process should improve the flow of information and reduce the friction involved in continually monitoring and updating the projected number of sorties a squadron should be able to generate. Individual squadrons are only required to maintain their aircraft and aircrew availability pages. The ACE battle staff will no longer have to manually calculate the projected sorties as it will be done automatically by the ACE ATO Support System with the most current information.

5. Process - Determine Amount Of Critical Resources Available

The ACE battle staff is the primary user of this process. The ACE battle staff relies on the flow of information from email, phone calls and message traffic from the resource managers to track this process. After collecting the inputs, the ACE battle staff completes spreadsheet-style forms with the updated information and distributes the forms throughout the ACE battle staff working area. Due to the lag in displaying the information on the forms, and the continuous change in the inventory of the critical resources, the information on the forms can quickly become obsolete.

a. Requirements and critical success factors

Both in peacetime and during wartime operations, the ACE will likely operate out of several different airfields. Each airfield will have its own supply of

ordnance and consumables (jet fuel) on hand to support the local squadrons. As these resources are expended, the ACE battle staff must have a means of tracking availability in order to plan timely resupply and maintain efficient use of assets. Intranet-based decision support for this process must present accurate, reliable information in a timely manner that is adjusted whenever the status of an airfield's critical resource needs to be updated. The information should be provided so that the decision-maker can pull it off the ACE ATO Support System as needed. The information should be clear, concise, and easily understood to enable the decision-maker to transform the information into knowledge and understanding that will lead to good decisions.

b. Process and data models

This process requires the responsible resource managers to maintain the information on any critical resource assigned to them. The entities for this process include the base or airfield where the resource is located and the resource itself. Figure 23 is the data flow diagram for critical resource availability, and Figure 24 depicts the relations between tables for these entities.

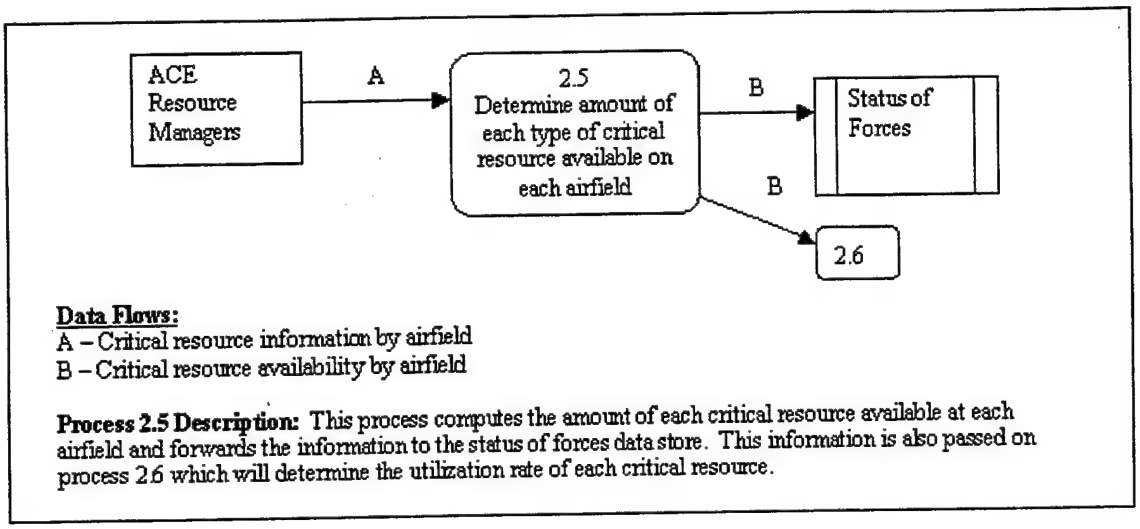


Figure 23. Resource availability DFD

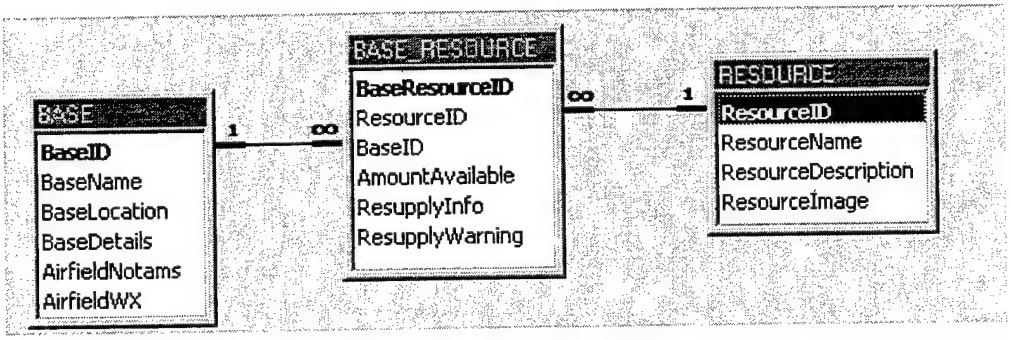


Figure 24. Resource table relationships

c. Prototype displays and dialogue

The ACE ATO Support System allows the user to select a specific resource to view information for that resource (Figure 25). After the user selects a resource, the prototype displays the total number available throughout the entire ACE and also lists the number available at each airfield. The user has the option of updating resource information or viewing resource usage. The resource usage display provides Intranet-based decision support to the decision-maker by revealing:

- How much of the resource is on hand (highlighted in green).
- How fast it is being expended.
- How quickly it will need to be resupplied (highlighted in yellow).
- How quickly it will be exhausted (highlighted in red).

The user also has the ability to enter his own usage rate. This allows the user to model what effect increasing or decreasing the usage rate will have on the resupply and exhaustion values.

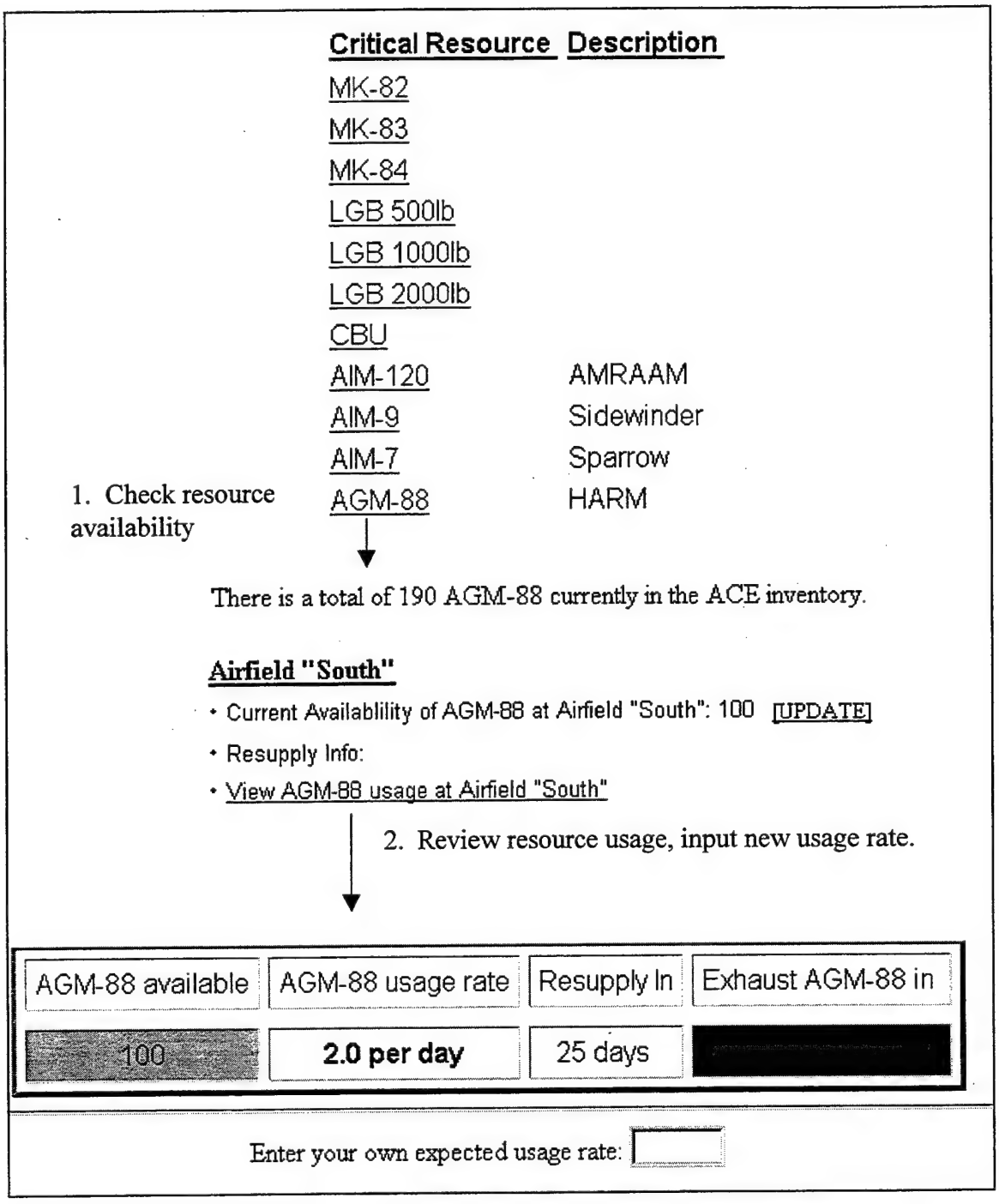


Figure 25. Resource web pages

d. Implementation procedures

The squadron assigned responsibility for each of the specific critical resources in the ACE ATO Support System would be tasked with maintaining the database. The squadron would appoint select individuals to enter changes to the database as needed. Units would have update privileges only to the resource they are responsible for maintaining. All users could view the information at any time.

e. Interoperability issues

This process should improve accuracy and flow of information between the ACE battle staff and the responsible resource managers. The ACE battle staff will have no administrative responsibilities for this process as the information will available in a "demand-pull" environment. The resource managers are in the best position to maintain their information and they will be able to do so quickly and efficiently by completing Intranet-based forms rather than phone calls, email and message traffic.

6. Process – Determine Availability Of Special Equipment

Along with tracking the availability of critical resources, the ACE battle staff tracks the status of special equipment. Special equipment can include aircraft pods that can be easily shuffled between aircraft, ground-based radars, command and control equipment, or maintenance equipment. Currently, the resource managers provide their inputs to the ACE battle staff to update the status of the special equipment they are

holding. This information is manually entered on a grease board or speadsheet and displayed throughout the ACE battle staff working area. However, this information is not normally made available to the entire ACE. As with the critical resources information, the information on the special equipment is quite perishable and must be continuously updated to stay relevant.

a. Requirements and critical success factors

Since much of the special equipment can be considered critical to the success of the ACE, the importance of maintaining the status on this equipment can not be overstated. The ACE battle staff requires easy access to the status of special equipment, and the information should be available when needed in a "demand-pull" environment. When the information is pulled, it should be straightforward and to the point and should always reflect the most current information.

b. Data model

This process was not part of the original requirements structuring. However, during the prototyping phase, potential users recommended that this process should be included. The entities for this process were studied and added to the ACE ATO Support System database. These entities include the unit assigned control of the special equipment, and the special equipment itself. Although there is no data flow diagram for this process, Figure 26 depicts the relations between the tables for the entities.

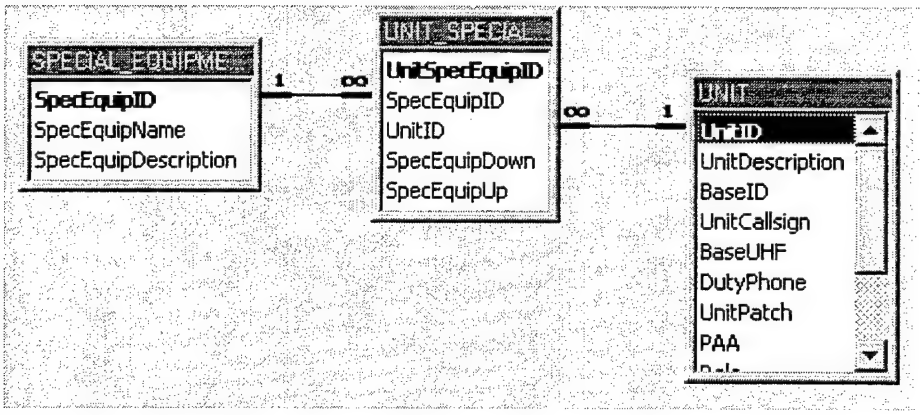


Figure 26. Critical equipment table

c. Prototype and dialogue

The ACE ATO Support System lists all of the special equipment items that are considered critical assets. From this list, the user selects an item to drill down for additional Intranet-based decision support for that item (Figure 27). The user is shown the total number of the selected item held by any squadron as well as the number in an "Up" or "Down" status. Selected individuals can also update this information by clicking the "Update" link.

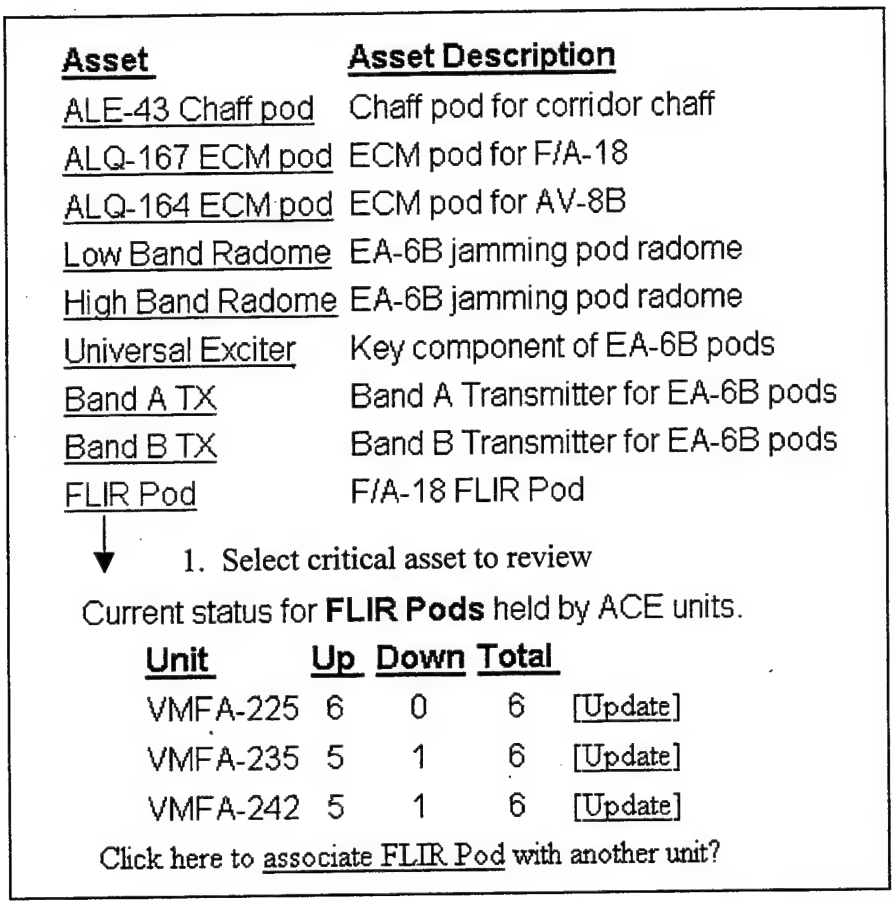


Figure 27. Critical asset web pages

d. Implementation procedures

As a unit is assigned responsibility for a critical asset, the unit would also assume responsibility for maintaining the information on the asset in the ACE ATO Support System database. All users can view the status of critical assets, but only the units responsible for the item would be able to update it.

e. Interoperability issues

This process should improve the ability of the resource managers and the ACE battle staff to share information and provide decision support for any issues involving the ACE's critical assets. The ACE battle staff becomes a customer of the "demand-pull" environment and no longer needs to try and manage the information itself.

C. EXAMPLES OF ATO PROCESSES

1. Process – Monitor Status Of ATO (ACE Level)

The ACE Current Operations Directorate has responsibility for this process. This process receives information from email, phone calls, radio traffic, and C4I systems such as CTAPS, IAS and TCO. The Current Operations Directorate fuses the information to build a picture of how the current ATO is being executed. Some of the information is displayed on the C4I systems, but a great deal of the information is still handwritten on grease boards in the Current Operations working area.

a. Requirements and critical success factors

The information displayed on the C4I systems does not present the entire picture. The use of grease boards helps paint the picture of the ATO, but it is limited in use to only those close enough to view it. To optimize coordination within the ACE and synchronize activities among all the participants in the ATO, the ACE requires accurate information presented in a clear, easy to understand format. This information must be available at the ACE battle staff level and all the way down to the squadron ready rooms.

As updates to the ACE ATO Support System are received, they should become immediately available for "demand-pull" decision support.

b. Data model

As previously explained, the entire ATO is a complicated process. The data model describing the ATO is equally complicated. The entities involved in the ATO model include the ATO itself, all of the packages associated with the ATO, all of the missions associated with each package, and all of the sorties associated with each mission. Every sortie is composed of an aircraft and at least one aircrew from a unit. If the aircraft has multiple aircrew, then each aircrew must have a specific seat in the aircraft (e.g., pilot, co-pilot). For every mission, one of the aircrew will be designated the mission commander. For every package, one of the mission commanders will be designated the package commander. Figure 28 depicts the complicated relationships between the ATO-related tables.

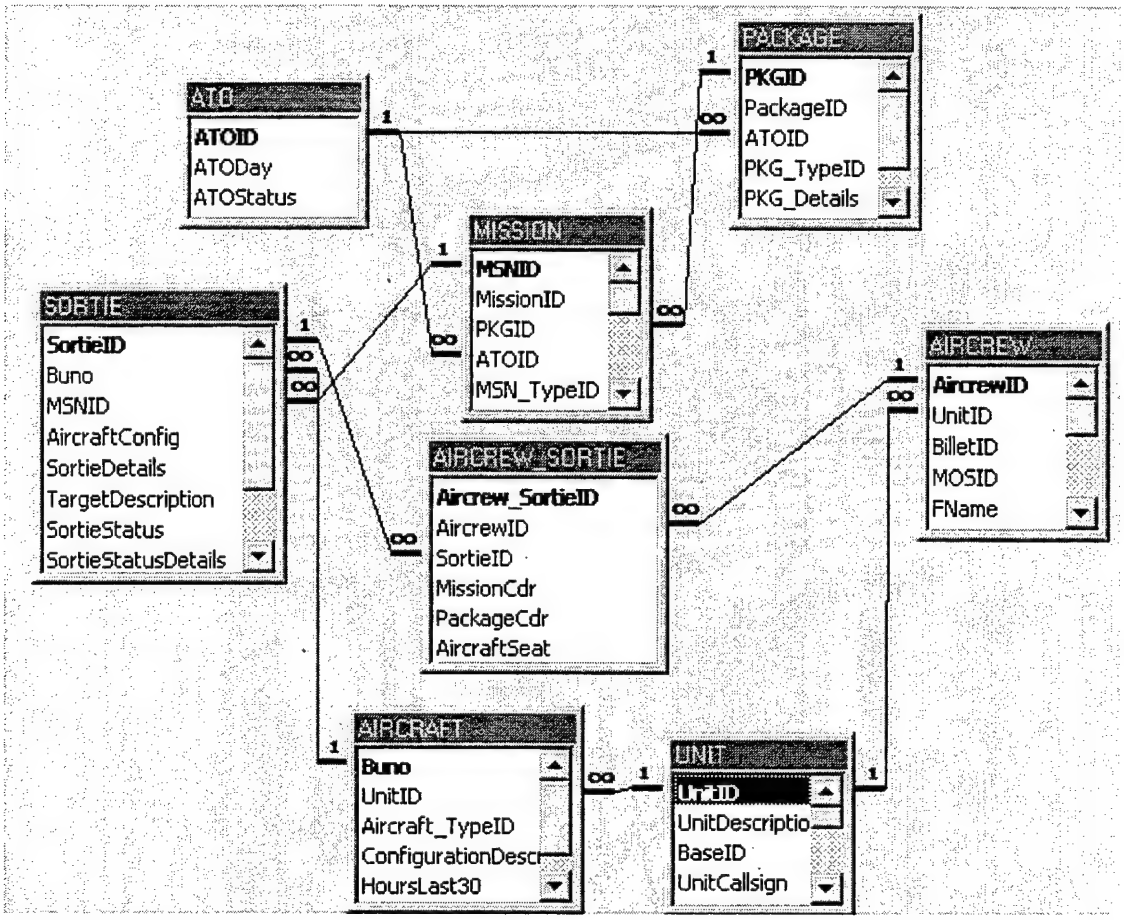


Figure 28. ATO table relationships

c. Prototype displays and dialogue

The ACE ATO Support System allows the user to view either the current ATO or a previously completed ATO. After making a selection, the user is shown all of the missions for the selected ATO (Figure 29). The status of the mission is highlighted to catch the user's eye. A brown background means the mission is on the ground waiting to go flying or has already landed. A blue background means the mission is currently in the

air. The user can select a package ID or a mission ID to drill down for additional information. This big picture display also gives the callsign of the mission, the mission type, status, and timing information for each mission (e.g., take-off, time on target, time off target, land time).

As the user works his way through the information by drilling down, he is provided more detailed information at each level. As Figure 29 depicts, selecting the package ID reveals additional information about the package. By selecting mission ID, the prototype reveals mission related information. Eventually, the user can drill down all the way to the actual aircraft and aircrew that make up one of the sorties for the mission.

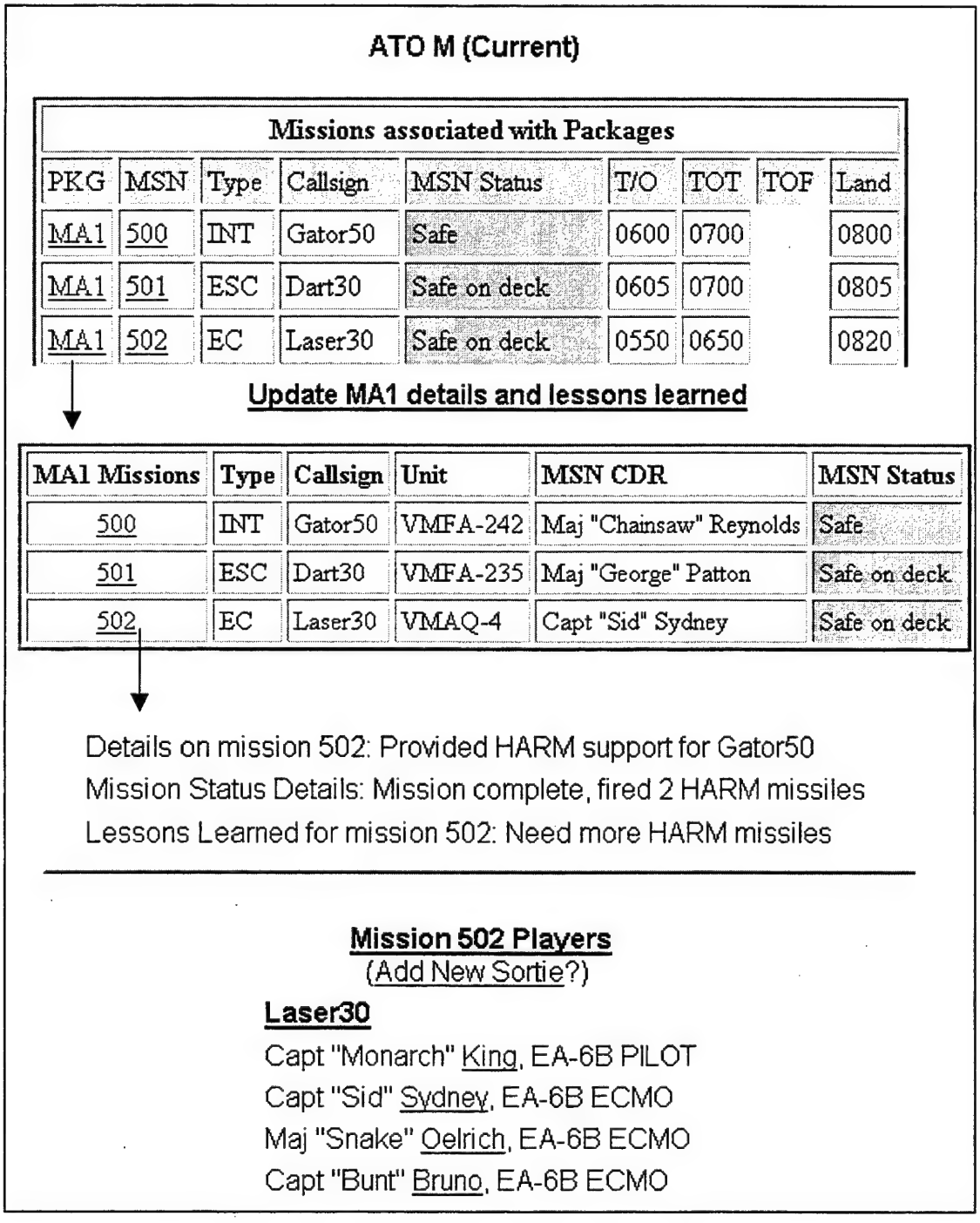


Figure 29. ATO mission information web pages

d. Implementation procedures

Rather than rely on grease boards to present current ATO information to the limited audience of the Current Operations Directorate, this process could provide the entire ACE with high quality Intranet-based decision support. Inputs to the process could be made from several sources, both at the ACE battle staff level based on their latest information, as well as by the resource managers who know the current status of their sorties and missions. At the squadron level, the squadron operations duty officer (ODO) monitors the squadron's participation in the ATO. The ODO could directly enter changes to the ACE ATO Support System database rather than phone or email updates to the Current Operations Directorate.

e. Interoperability issues

Th consequences of implementing this process would have a significant impact on the way the ACE monitors the ATO. Rather than spend their time fusing and administering ATO data, the Current Operations Directorate becomes more of a "demand-pull" customer and still retains the ability to make its own updates. This concept represents a fundamental shift in the whole ATO process. This process also opens up the flow of information to squadrons who do not normally have access to the C4I systems and certainly can not view the grease boards. By making this process available to everyone over the ACE Intranet, the entire ACE enjoys increased situational awareness and each unit has a better understanding of how their role fits into the big picture.

2. Process – Monitor Status Of ATO (Squadron Level)

This process is similar to the one described above but has application at the squadron level of the ACE hierarchy. Currently, a squadron can only monitor ATO execution from its own perspective, since typically lacks connectivity to the C4I systems and is far removed from the Current Operations grease board. The squadron ODO keeps the squadron ATO information current by receiving data from the squadron sorties as they launch and recover from ATO missions. This data is communicated from the aircraft to the ODO by UHF radio calls. As the ODO receives updates on the progress of a squadron mission, he updates the ODO grease board. This procedure is used on a daily basis during peacetime training as well as operational flying.

a. Requirements and critical success factors

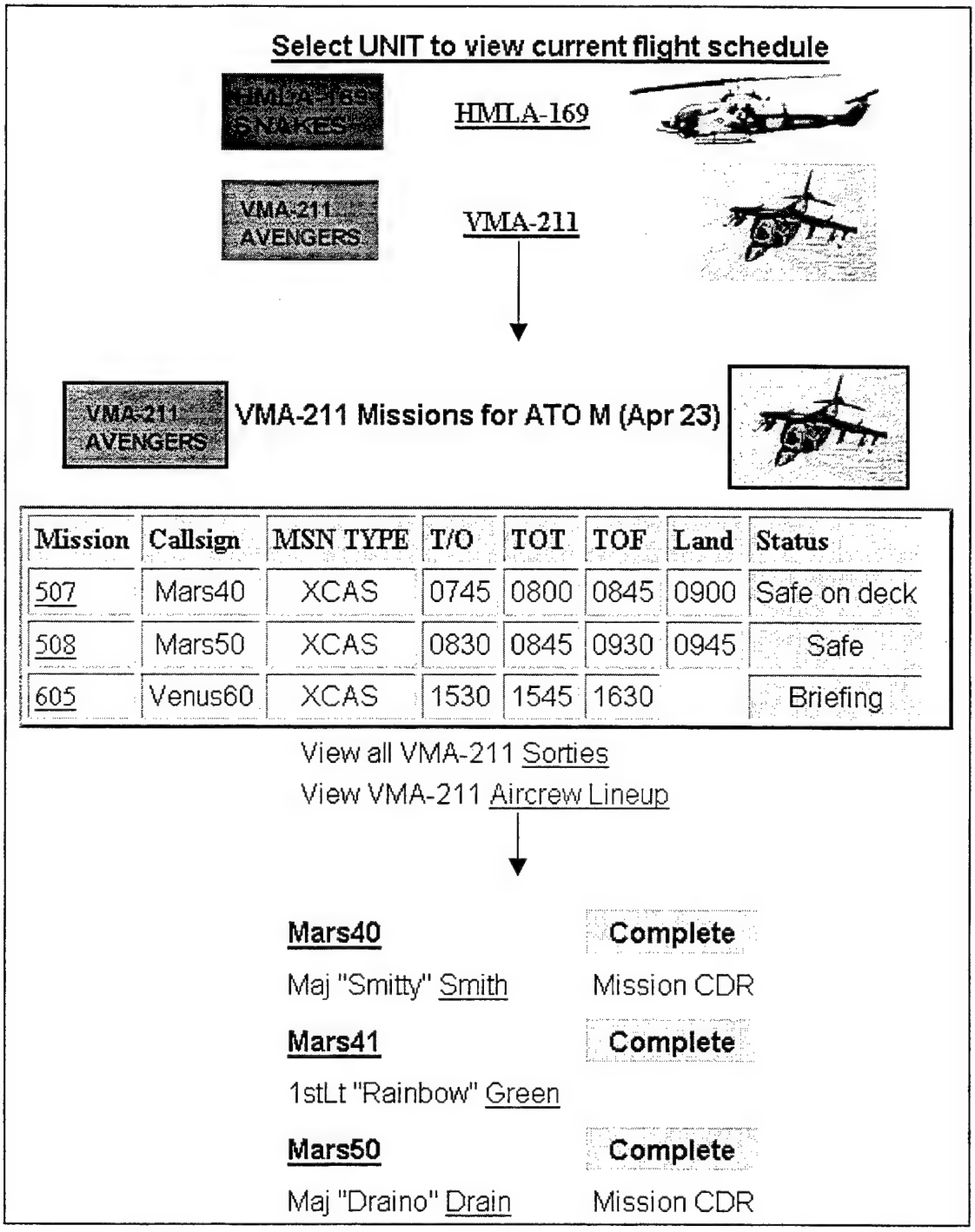
Rather than having to rely on viewing the ODO grease board, squadron members should be able to view current squadron ATO information using the ACE ATO Support System. This information should be presented in a clearly understood and meaningful format. Updates to the squadron's ATO status should be easily and swiftly made. Intranet-based decision support should be available not only to the responsible squadron but should be shared by the entire ACE to enhance overall situational awareness. Sharing this information throughout the ACE leads to knowledge and understanding of how well the squadron is meeting its ATO tasks, and how well the entire ACE is performing.

b. Data model

The data model for the squadron level ATO process is the same as the ACE level ATO process (Figure 28 above).

c. Prototype displays and dialogue

The ACE ATO Support System allows the user to select a squadron to view. The initial screen, as depicted in Figure 30, lists all of the missions assigned to the squadron for the current ATO. The screen follows the same color patterns for highlighting mission status as the ACE level process – blue for airborne, brown for on deck. The user can view additional information by selecting the mission ID for a mission of interest. From this page the user can view details, timing aspects, and personnel information for the mission. The user can also drill further down to view lineup information that shows the mission commanders for each mission. Although it is not shown, the prototype also allows the user to view information on the aircraft assigned to the sortie.



Mission	Callsign	MSN TYPE	T/O	TOT	TOF	Land	Status
507	Mars40	XCAS	0745	0800	0845	0900	Safe on deck
508	Mars50	XCAS	0830	0845	0930	0945	Safe
605	Venus60	XCAS	1530	1545	1630		Briefing

Figure 30. Squadron sorties web pages

d. Implementation procedures

As he does now, the squadron ODO would be responsible for maintaining the ODO board. However, by migrating this process to a Intranet-based decision support function, the ODO board becomes web-based and available for the entire ACE to view. Only the squadron ODO would be able to make changes to the squadron sortie information, except for mission status. Since the aircraft are often out of UHF communication range with the ODO, other ACE command and control agencies would be capable of updating the sortie and mission status if they are in contact with the mission aircrew.

e. Interoperability issues

This process would significantly improve the ability of the squadrons to share vital information with the rest of the ACE. Since squadrons still need to coordinate despite being physically separated, this Intranet-based decision support tool allows the entire ACE to share a common picture of the ATO. This tool should cut down on the number of phone calls and confusion that are routinely experienced when two or more squadrons try to coordinate operations from different airfields. Some of this information is available on CTAPS, but CTAPS is rarely found down at the squadron level and it requires a significant amount of training to use. A web-based ODO board is easily understood and operated by anyone familiar with a web browser. All updates to the system are displayed in a meaningful format to the people who need them.

D. EXAMPLES OF OTHER DECISION SUPPORT PROCESSES

1. Displaying Unit Information

This process provides the user with a quick and easy means to find important information for units in the ACE. After selecting a specific unit, the user is presented with the displays in Figure 31. The unit information provides links to the current flight schedule, a short of key billet holders as well as a list for all of the squadron's billets. The page also has links that lead to the aircraft, aircrew, and critical asset web pages for the selected squadron.

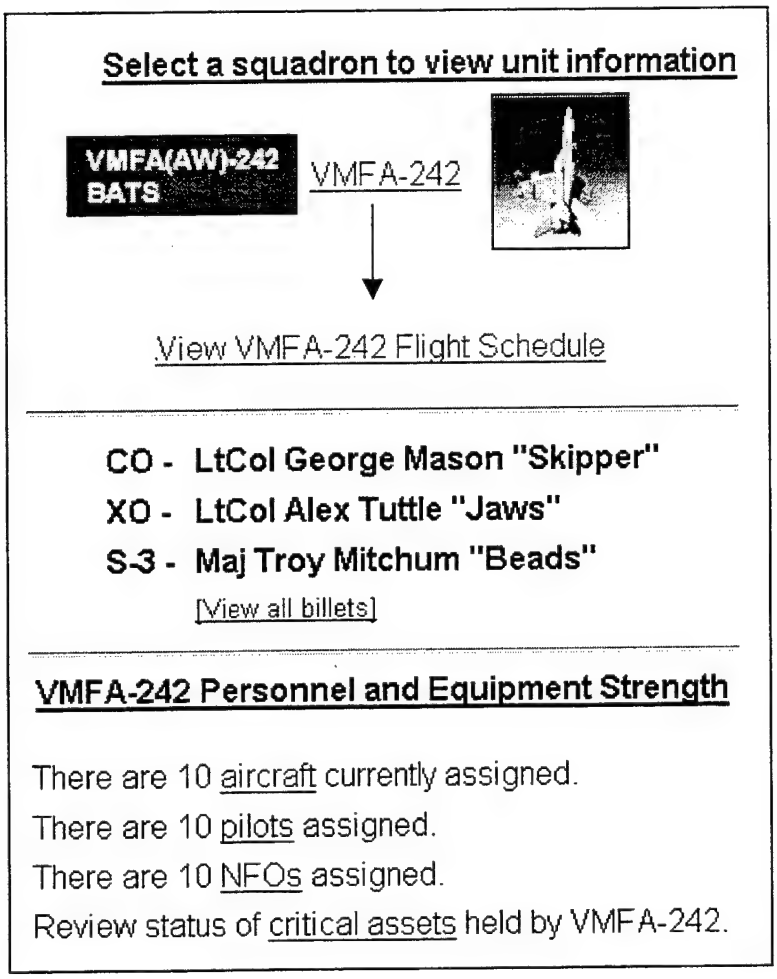


Figure 31. Unit information web page

2. Database Search Tool

Due to the large number of personnel in the ACE, the ACE commander and his staff will encounter difficulty keeping tabs on the Marines under his command as well as their qualifications and billets. By incorporating a simple database search tool in the ACE ATO Support System, the ACE commander can quickly determine who all of his "Top Gun" qualified aviators are and which units they belong to (see Figure 32). Armed

with this information he can select some of these highly qualified aircrew to perform special missions. This is yet another example of how Intranet-based decision support transforms information into knowledge and eventually into an understanding that leads to a decision by the decision-maker.

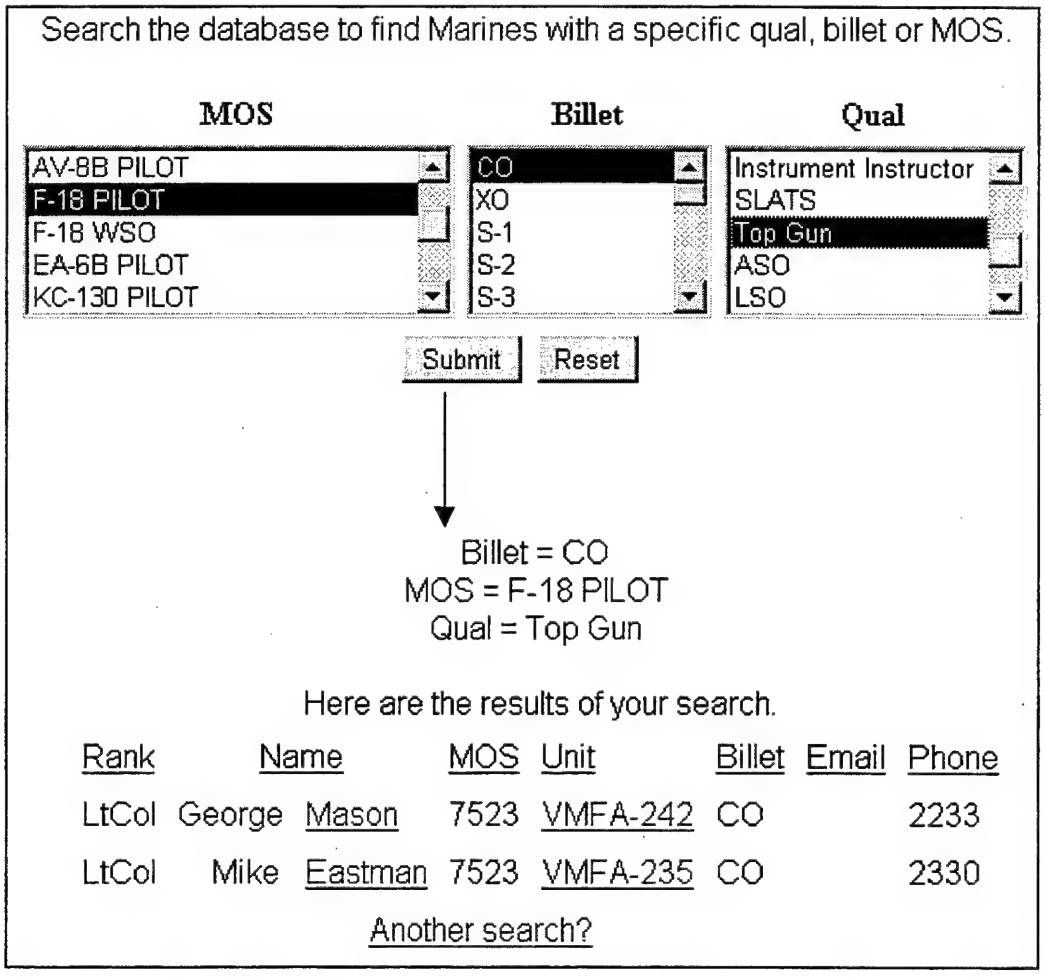
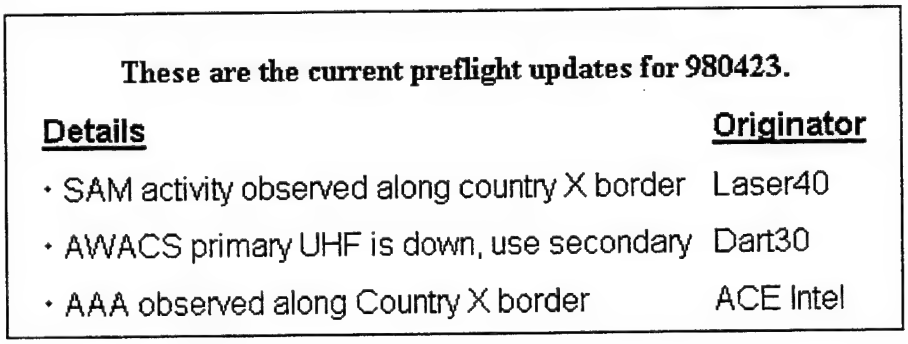


Figure 32. Database search web pages

3. Critical information

The ACE ATO Support System is intended to become a central part of the ATO process. As such, ACE personnel would be expected to adapt to the change in procedures associated with the ACE ATO Support System. One primary change in procedures would be the need to continually check for critical information under the prototype page labeled "Preflight information." This page, as depicted below in Figure 33, offers a quick, concise means of pushing important information out to everyone who needs it. The example below shows only a few lines, but the potential for this page is unlimited. All types of information could be passed both ways between the ACE battle staff and the squadrons, as well as between squadrons. One recommendation would be to have all aircrew check this page as often as possible to gleam changes in the operational situation and increase their situational awareness. Aircrew would especially want to check it for last minute updates just prior to walking out to their aircraft. The ODO could also monitor this page and pass new information to aircraft within UHF range of the squadron ready room.



These are the current preflight updates for 980423.

Details	Originator
• SAM activity observed along country X border	Laser40
• AWACS primary UHF is down, use secondary	Dart30
• AAA observed along Country X border	ACE Intel

Figure 33. Preflight information web page

E. PROTOTYPE DEVELOPMENT CONSIDERATIONS

1. Design Considerations

As a prototype, the ACE ATO Support System was developed to demonstrate that Intranet-based decision support can be implemented for the ACE. The focus of the prototype was on functionality and not on aesthetics. However, several primary design considerations were established and adhered to throughout development. Web page design followed the general guidelines established by Jakob Nielson, a recognized expert in the field. On his web page, Nielson provides his top ten list of web page design considerations. [Ref. 31]

- Avoid use of frames
- Do not use bleeding edge technology if possible
- Avoid marquees, scrolling text, and animated graphics
- Keep URLs simple
- Make sure every page has a link back to the home page
- Avoid long scrolling pages
- Provide web site navigation help
- Use standard hyper link colors
- Ensure information is current
- Avoid long download times

The primary design consideration for the prototype was an emphasis on ease of use and clarity of information. This was accomplished by preventing the user from being overwhelmed with too much information on any web page by using links to provide access to other web pages with more detailed information.

Another consideration was the use of simple colors and plain text. Except for the initial welcome page, a white background was selected for each page to offer the best contrast for the text. Many of the pages will end up being printed by ACE personnel so the white background ensures the information will continue to be readable in hard copy form. Other colors were selected to follow common sense tendencies. Under the critical resource page, a yellow highlight signified caution or warning, red highlighted danger (supplies exhausted), and green signified no problems. Yellow was also used on the aircraft and aircrew availability pages to highlight assets that were not available. Under the ATO processes, the prototype consistently used brown and blue highlights in the mission status columns. A quick look at the current ATO page would tell the user that all of the brown highlighted missions are on the ground, while all of the blue missions are airborne.

The prototype made extensive use of centered, HTML tables for text and graphics to provide each web page with a structure that will stand up to the wide variety of monitors that the users will have. The system web pages were developed to fit on the 15" computer monitor that is commonly found throughout the ACE. Larger monitors provide an even better presentation.

The prototype placed an emphasis on ease of navigation. No frames were used as this often confuses the user as well as the developer. Each page includes the same header and footer template to give the entire prototype a standard look and feel. The header template includes a matrix of links that allows the user to navigate anywhere in the site,

including a link back to the main menu. Above the header is the current date and time that the page was sent to the client. This provides each page with a time stamp. The time stamp will prove useful when the page is printed out since it will show what was current in the database at that time. The navigation box is shown below in Figure 34.

(This information is current as of 980514, 15:10:05 Pacific Time)

ACE STATUS:	Availability	Airfields	Aircraft	Aircrew	Resources	Units
ATO INFO:	Current ATO	Previous ATO	Unit ATO	Preflight Info	Lessons Learned	
MISC:	Main Menu		Search Database		Tutorial	

Figure 34. Navigation menu

The main menu provides additional links including a link to the tutorial for the prototype, a link describing the operational scenario for the prototype and a link for the questionnaire for users to provide feedback. The main menu is shown in Figure 35.

ACE ATO SUPPORT SYSTEM PROTOTYPE

START HERE	ACE STATUS	ATO INFO	ADMIN STUFF
Overview of Prototype	Airfields	Current ATO	Billets (add)
Scenario	Resources	Previous ATOs	Mission Types (add)
Site Map	Aircraft	Unit ATO Info	Aircrew Quals (add)
Tutorial	Aircrew	Preflight Info	MOS (add)
Questionnaire	Availability	Lessons Learned	Database Search
Thesis Info	Units		Critical Assets

Figure 35. Main menu

2. Bandwidth Considerations

Bandwidth poses a serious concern for the ACE. The ACE ATO Support System will be competing for bandwidth along with all of the systems connected to the ACE SIPRNET. For this reason, the prototype design involves primarily text and very few graphics. All of the graphics are fairly small (15-20 KB) in size, and most of them are presented on the first page after entering the system. By having them load on the first page, the graphics are stored in the client computer's cache memory and can be quickly loaded whenever they are displayed again during the session.

3. Security Considerations

The ACE ATO Support System prototype includes a demonstration of how security could be implemented. To prove that users can be restricted from changing the database based on their access level, the prototype uses two levels of security. These two security levels are set based on the password entered on the welcome page. If the user enters as "Guest", he has full access to view everything in the prototype, but all of the "Submit" buttons are hidden. This provides a simple but effective means of controlling access. If the user enters with an established password, he has full access to view and update the database. The security access is passed from page to page by setting an HTML "cookie" that establishes the user's security level. As the user goes from page to page in the prototype, the "cookie" is passed. In the software code, the "cookie" is checked before the "Submit" button is displayed to the user. If the "cookie" has the

"fullaccess" tag set, the "Submit" button is shown to the user, allowing the user to enter updates (see Figure 36 below). If the "guest" tag is set, the "Submit" button remains hidden. The prototype provides only a simple proof of concept for this method, however, it did demonstrate that the ACE ATO Support System could support multiple users with multiple access levels. Using this kind of method, each squadron could be given an access code that only allows their personnel to update the squadron's information.

```
<cfoutput>
<cfif #Cookie.Privilege# IS 'fullaccess'>
<input type="Submit" value="Submit Callsign">
  <input type="reset" value="Reset">

</form>
</cfif>
</cfoutput>
</CENTER>


<cfinclude template="foot.htm">
```

Figure 36. Using a cookie to hide submit button.

V. HARDWARE AND SOFTWARE SUPPORT

A. HARDWARE

The ACE ATO Support System prototype was developed using two computers. The primary computer, located in the INTEROP lab in Ingersol room 364E, was attached to the Internet through the Naval Postgraduate School local network. This machine had a Pentium 166 MHz processor with 64 MB of RAM, used NT Server 4.0 as its operating system, and served as the file server and web server for the prototype. All of the HTML files and the Microsoft Access database files were located on the primary computer. The author's personal computer served as the second computer for prototype development. This computer had a 100 MHz processor with 32 MB of RAM and used Windows 95. Internet access was simulated on the second machine by using the local host TCP/IP address of 127.0.0.1. Once an application completed development on the secondary machine it was transferred to the primary machine for public access.

B. SOFTWARE

A variety of software applications were required to complete the prototype. These software applications can be lumped together in three groups: internet support, design support, and database support. Intranet-based decision support depends heavily on accessing and manipulating database information which requires a sound understanding of Structured Query Language (SQL). Intranet application development also requires a

solid understanding of HTML. Integrating SQL and HTML then becomes the most critical part of successful Intranet-based decision support. Selection of a good software tool that worked well with HTML and SQL proved to be an important step in the development of the ACE ATO Support System prototype. Along with the quality of the software tool, the cost, availability, and the ease of use of the tool should also be considered during selection.

1. Internet Support

Internet support for the prototype includes selecting a web server responsible for displaying information from the prototype to the user. Microsoft's Internet Information Server 3.0 (IIS) was selected for this prototype primarily because it comes with NT Server 4.0. The author had built a smaller Intranet application for a separate project that originally ran under WebSite Pro 1.1. This other Intranet application routinely crashed until IIS 3.0 was loaded. Neither this prototype nor the other Intranet application has had a problem since going with IIS 3.0. Microsoft's Personal Web Server is essentially the Windows 95 version of IIS 3.0 and was used on the secondary machine.

Close behind in importance to the web server is the tool that integrates the HTML and SQL for the web server to display information to the client browser. Cold Fusion Application Server 3.1 workgroup edition was selected as the primary software tool for integrating HTML and SQL. The Cold Fusion tool actually functions as a service of NT Server and is therefore running at all times on the computer. When a browser client

sends a request for information to the IIS web server, the Cold Fusion service parses the request and processes any of the special Cold Fusion tags it finds in the request. Regular HTML tags are processed only by IIS. The web server sends the output from the Cold Fusion tags and the HTML tags back to the client browser.[Ref. 32]

Cold Fusion Application Server 3.1 comes in two versions, workgroup and professional editions. The workgroup edition is designed primarily to support smaller scale Open Database Connectivity (ODBC) database products such as Access, Paradox, dBASE and Visual FoxPro. The workgroup edition lists for approximately $500. The professional edition provides compatibility for any ODBC compliant database such as those offered by Oracle, Sybase and Informix. The professional edition lists for approximately $1000.

2. Design Support

There are wide variety of HTML and web authoring software tools available on the market. Many of the latest products such as NetObjects Fusion and Front Page 98 are user friendly and allow the developer to work in a WYSIWYG environment. However, to maximize the capabilities of Cold Fusion, the web authoring tool must be Cold Fusion compatible and should allow the developer to easily view and work with the HTML source code. For this reason, along with the desire to really learn HTML, the author opted to rely on a text-based web authoring tool. Cold Fusion Studio was selected since it provides a text-based environment along with numerous wizards for manipulating the

Cold Fusion tags. Cold Fusion Studio also offers the additional advantage of including its own ODBC compatibility with the target database. This allows the developer to form his own queries and view the results without leaving the Cold Fusion programming environment. Once the query produces the correct results, the developer can use the Cold Fusion Studio query wizard to drag and drop the query straight into the HTML source code.

3. Database Support

Along with Cold Fusion Studio, Microsoft Query proved to be an invaluable resource for developing and refining the database queries for the prototype. Microsoft Query provided a very logical means of manipulating the database to get the desired results from SQL queries. Since this prototype was heavily dependent on complex SQL queries, Microsoft Query often proved easier to work with than the Cold Fusion Studio query wizard. Microsoft Query comes with Microsoft Office 97 Professional Edition.

VI. LESSONS LEARNED AND RECOMMENDATIONS

A. LESSONS LEARNED

This section provides discussion on some of the more significant lessons learned during the development of this prototype. Some of the most important lessons learned during this thesis project had very little to do with the technical aspects and more to do with the management aspects for this project.

1. Change Management

The concept behind the ACE ATO Support System represents a significant shift in the way of doing business for the ACE. Intranet-based decision support should enhance the situational awareness of the ACE and improve the coordination and interoperability of the ACE. Despite this seemingly obvious potential, the ACE ATO Support System generated only lukewarm acceptance from the fleet users who tested the prototype. When some of the concepts of change management are applied to this project, the reasons for this lukewarm acceptance become quite clear. Michael A. Beer developed a formula that highlights the importance of not only developing a tool for change but the need for properly managing the change. [Ref. 33]

Amount of change = (Dissatisfaction X Model X Process) > Cost of Change

If the formula is applied to this project, the model is the vision of the future state for the ACE. In this case, the vision would be a highly interoperable, well coordinated

ACE that overcomes distance and physical separation to improve overall situational awareness. The ACE ATO Support System represents the means to this vision. The cost of change would be the level of effort and expense required to implement the ACE ATO Support System. Since the formula is multiplicative, it requires both a process to achieve change and a level of dissatisfaction within the organization (ACE) to understand that change is required. For this project, the process would involve a sequence of events to gain increased support and commitment for the ACE ATO Support System. Dissatisfaction can come from the top down or bottom up. Dissatisfaction from the bottom up in this case could mean individual Marines or units of the ACE who understand there is a better to way to perform the processes of the ACE and push for change. Due to time constraints and resources, gaining commitment for the concept of Intranet-based decision support for the ACE and raising the level of dissatisfaction proved to be beyond the scope of this thesis. Without strong sponsorship from key individuals or commands and a sense of dissatisfaction with the existing system, the ACE ATO Support System likely faces an uphill climb to acceptance and successful implementation.

Daryl Conner provides additional reasons why change management can prove to be more difficult to overcome than technical problems. Conner describes the need to identify and fill four major change roles for successful implementation.

- The change advocate, who proposes change but lacks sponsorship.
- The change sponsor, who legitimizes the change.

- The change target, namely, the individuals or groups that must undergo change;
- The change agent, namely, the individuals or groups that must implement the change. [Ref. 34, p. 179]

The ACE ATO Support System lacks the support of a change sponsor and a change agent. The ideal candidate for a change sponsor would be a Commanding General of a Marine Air Wing. With his support behind the concept, the General's staff would easily be able to identify a change agent to implement Intranet-based decision support for the ACE.

2. Cold Fusion

Cold Fusion Application Server and the Cold Fusion Studio products proved to be excellent tools for developing Intranet-based decision support. There is a significant learning curve in getting started with Cold Fusion, but once the basic concepts of the Cold Fusion tags are understood the web page development process becomes a matter of good software engineering. This project ended up requiring approximately 112 separate Cold Fusion files or pages. Cold Fusion provides good tools for managing and editing all of these pages. If this prototype were adapted and implemented by the Marine Corps, Cold Fusion would still be a good choice as the tool for integrating the HTML and SQL for Intranet-based decision support.

3. Database Structure And Design

The importance of a well thought out data model can not be over emphasized. The structure of the tables and the relationships between the numerous tables for this project had to be correct before any Cold Fusion pages could be developed. If the tables or relationships were faulty, a great deal of time would have been lost in troubleshooting and rewriting the SQL queries in the Cold Fusion files. Access allows the use of "auto numbers" for use as the primary key for a table. This was a very helpful feature for entities that did not have a natural or obvious means of being uniquely identified.

B. RECOMMENDATIONS

1. CTAPS Compatibility

The ATO process is heavily dependent on CTAPS, and CTAPS is the accepted joint system for developing, disseminating and executing the ATO. The ACE ATO Support System is not capable of replacing CTAPS, but instead offers the opportunity to extend the information available on CTAPS to units in the ACE that do not have access to CTAPS. CTAPS runs on ODBC compliant databases (Oracle and Sybase) which are fully supported by Cold Fusion Application Server, professional edition. The next logical step for this prototype is to investigate the capability of an Intranet-based decision support system like the ACE ATO Support System to pull ATO information directly from the CTAPS database using Cold Fusion. This would enable the entire ACE to view

CTAPS information without having to purchase additional CTAPS units. Instead, ACE units with common Pentium class computers attached to the ACE SIPRNET could view and update ATO information with a regular web browser. This concept fully supports the ideas behind IT-21 and the Marine Corps policy of moving to a PC-based, NT Server environment. [Refs. 35 and 36]

2. Architecture for ACE Intranet

The current ACE Intranet really does not go beyond the confines of the working area of the ACE headquarters. To fully leverage the benefits of Intranet-based decision support, the Marine Corps should evaluate the requirements for the architecture to support an ACE-wide Intranet. This review should determine what improvements are needed to connect all units of the ACE no matter their location or distance from the ACE headquarters. To provide the level of Intranet-based decision support needed by the ACE, an architecture for the ACE C4I systems (TAMPS, GCCS, AFATDS, TCO and IAS) needs to be developed with the appropriate technology to support bandwidth demands. This architecture should also support web browsing of a system like the ACE ATO Support System by anyone attached to the ACE SIPRNET with a Pentium class computer.

3. Additional Features For Prototype

As a result of feedback received from fleet users who reviewed the prototype (see appendix D for comments), several ideas for additional features were generated. One of

the first recommendations was from a Marine with a weather background who suggested integrating the capabilities of a new aviation weather system into the prototype. The ACE ATO Support System has a very limited section for weather, so this recommendation has a lot of merit. By integrating the new weather system into Intranet-based decision support, the entire ACE would always have access to the latest weather information over the ACE Intranet. The weather information could include weather in the target area, ceilings and visibility in the refueling areas, and weather for the primary and alternate airfields. This type of information is currently only available by fax or phone call from the airfield weather office.

Another suggestion from a fleet user is to include additional information on aircrew training. Specifically, each aircrew maintains a certain level of currency for a special skill. One example is the skill and training required for conducting night operations with night vision goggles. A mission planner would want to know which aircrews were qualified for this mission and the currency of the qualification.

4. Electronic Flight Schedule

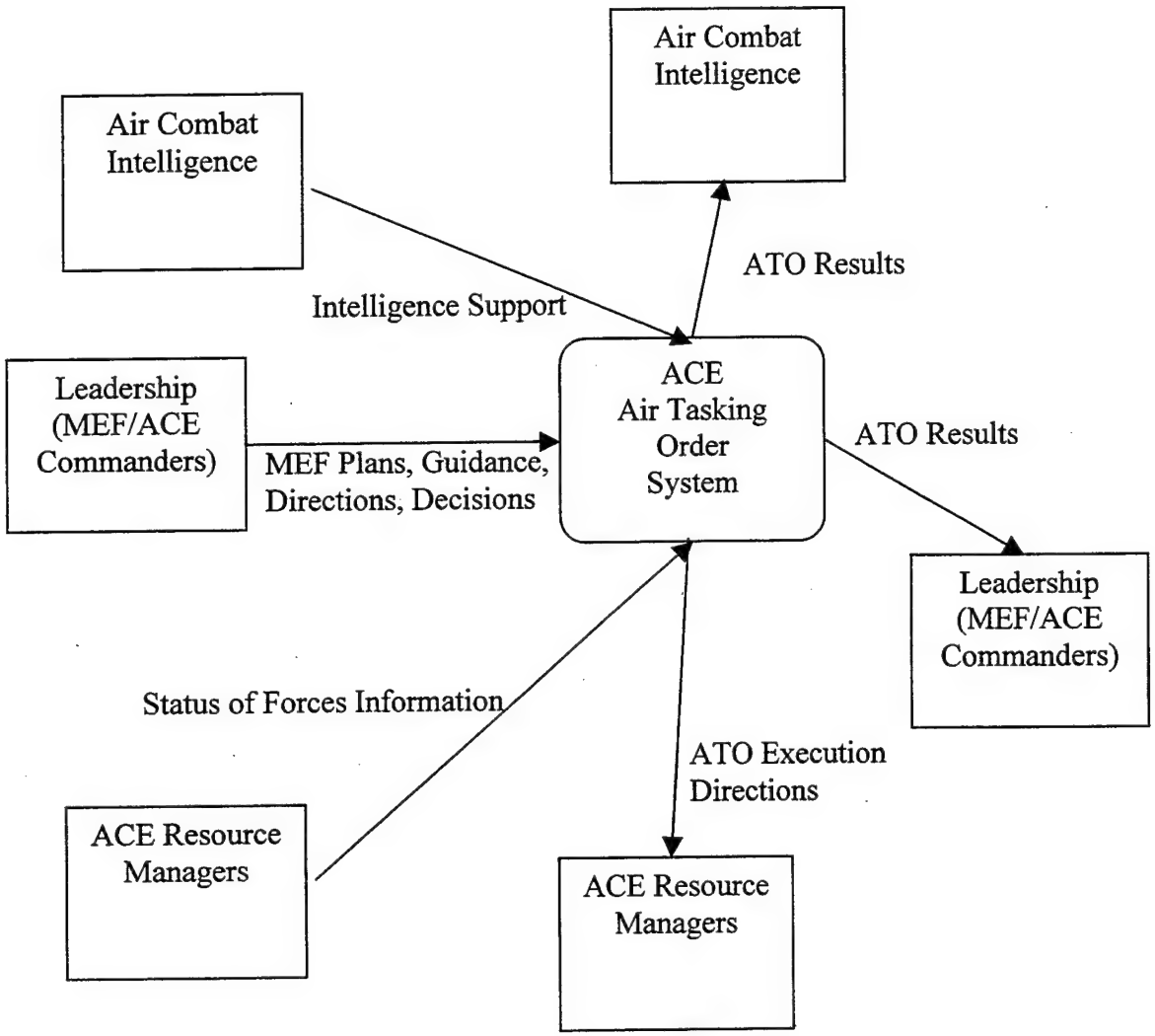
After viewing the ACE ATO Support System, an officer from Marine Aviation Weapons and Tactics Squadron One (MAWTS-1) described an electronic flight schedule program that MAWTS-1 is trying to develop in house (see appendix D for more details). This project would be an excellent follow on to the ACE ATO Support System and could provide thesis opportunities for several students. MAWTS-1 is responsible for training

and instructing the top aviators in the Marine Corps. Each year MAWT-1 holds two Weapons and Tactics Instructor (WTI) courses over a six week period. As part of WTI, the students in the course fly in numerous large scale exercises. Each of these exercises requires a great deal of coordination between students, instructors, maintainers and range personnel to produce the exercise flight schedules. An electronic flight schedule could take advantage of the new Intranet recently installed at MAWTS-1 and help the coordination and decision making processes associated with these WTI exercises. The electronic flight schedule would serve a variety of functions, several of which the ACE ATO Support System already performs. Some of the proposed functions include:

- Range scheduling and deconfliction
- Aircrew scheduling (up to 15 minute intervals during the day)
- Matching aircrew qualifications with sorties qualification requirements
- Management of flight schedule notes
- Ordnance management using standard conventional loads.

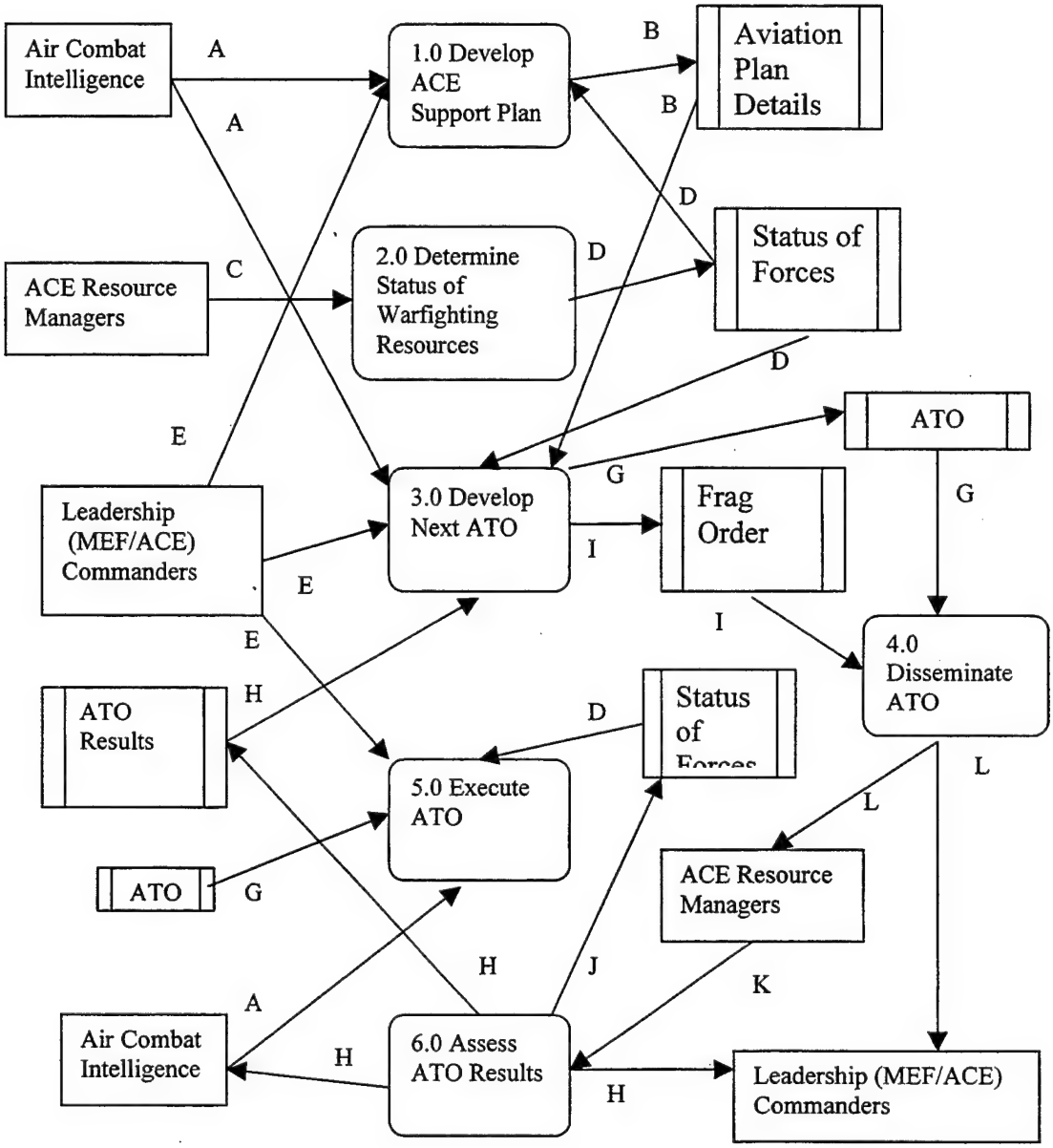
Concepts such as the electronic flight schedule and the ACE ATO Support System are excellent examples of how Intranet-based decision support can improve and enhance the situational awareness and decision making abilities of the ACE.

APPENDIX A. ACE SYSTEM ANALYSIS



ACE ATO SYSTEM - Level 0

ACE ATO System – Context Level



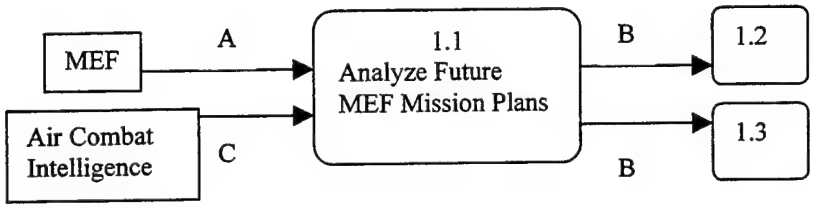
Context Level Data Flows

A – Intelligence Support
B – Aviation Plan
C – ACE Asset Information
D – Status of Forces
E – MEF Plan and Leadership Guidance
F – ATO Execution Directions
G – Next ATO
H – ATO Results
I – Frag Order
J – Update to Status of Forces
K – ATO Debrief Information
L – ATO and Frag Order

Process 1.0 Data Flows

A – MEF Mission Plan and Guidance
B – Intelligence Support
C – Analysis of MEF Mission Plan
D – Courses of Action (COAs)
E – Estimates of Supportability
F – COA Briefs
G – Status of Forces
H – Selected COA
I – Aviation Plan

Process – 1.1



Data Flows:
A – Future MEF Mission Plan and MEF Guidance
B – Analysis of MEF Mission Plan
C – Intelligence support

Process 1.1 Description: This process receives the MEF's requirements for its Future Mission Plan, and the current intelligence information. This process involves conducting an initial analysis of the MEF's requirements in preparation for developing possible courses of action for the ACE Commander to review.

1. **What entities does this process affect?**
   ACE Aviation Plan
   Estimate of Supportability
   Intelligence Support
   MEF Future Mission Plan

2. **How many users does this process have?**
   The Future Plans Directorate has up to 18 Marines working in it. Of those 18, only 6 to 8 will actually be working on this process.

3. **Who is the primary owner of this process?**
   The Director of Future Plans/Strategy Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is normally conducted whenever the MEF forwards its future mission plan. Normally this would be done every two or three days, possibly as often as every day.

5. **How often is this process updated?**

The process is updated on a daily basis, since the intelligence picture is always changing. The MEF usually provides new Future Missions plans every three to four days, but could be as often as every day.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

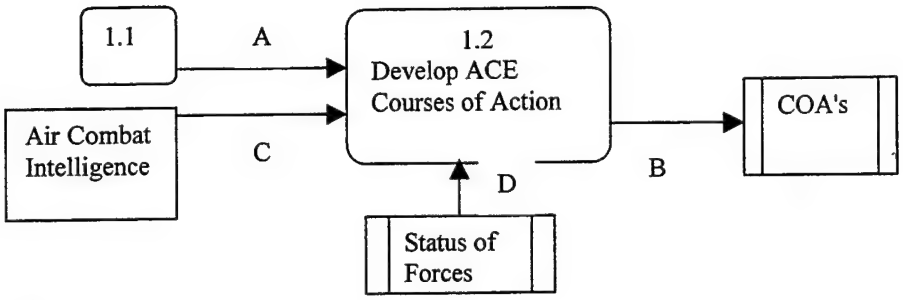
7. **What type of information does this process use?**
   This process uses customized information from the MEF and Intelligence. All of the information is classified and the volume will normally be low to medium.

8. **What is the source of information for this process?**
   Intelligence support information comes from database queries (IAS), briefings from intelligence personnel, and standard intelligence reports.
   The sources of information from the MEF come via e-mail, message traffic, briefings, meetings and reports.

9. **What is the current status of the process?**
   This process is partly automated since some of the information comes from word processing and databases. Some of the database queries are linked.

10. **Which C4I systems support this process?**
    The Intelligence Analysis System (IAS) provides the latest intelligence information on the enemy. The Tactical Combat Operation (TCO) provides the latest information on friendly unit locations.

Process – 1.2



Data Flows:

A – Future MEF Mission Plan and MEF Guidance
B – Courses of Action
C – Intelligence support
D - Current Status of Forces

Process 1.2 Description: This process develops estimates of supportability by the ACE's resources to meet the requirements of the MEF's Future Mission Plan. This process requires the current and projected status of forces information. From this process the Future Plans Directorate will have developed estimates of supportability to support the COA's that will be presented to the ACE Commander for his selection.

1. **What entities does this process affect?**
   ACE Aviation Plan
   Courses Of Action
   Future Plans Directorate
   Intelligence Support
   Warfighting Resources

2. **How many users does this process have?**
   All 18 Marines in the Future Plans Directorate will be working in this process.

3. **Who is the primary owner of this process?**
   The Director of Future Plans/Strategy Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is normally conducted whenever the MEF forwards its future mission plan. Normally this would be done every two or three days, possibly as often as every day.

5. **How often is this process updated?**
   The process is updated on a daily basis, since the intelligence picture is always changing. The MEF usually provides new Future Missions plans every three to four days, but could be as often as every day. The Future Plans/Strategy Officer will continually be developing and refining courses of action for the ACE Commander.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   All of the information is classified and the volume will normally be low to medium.

8. **What is the source of information for this process?**

Intelligence support information comes from database queries (IAS), briefings from intelligence personnel, and standard intelligence reports.

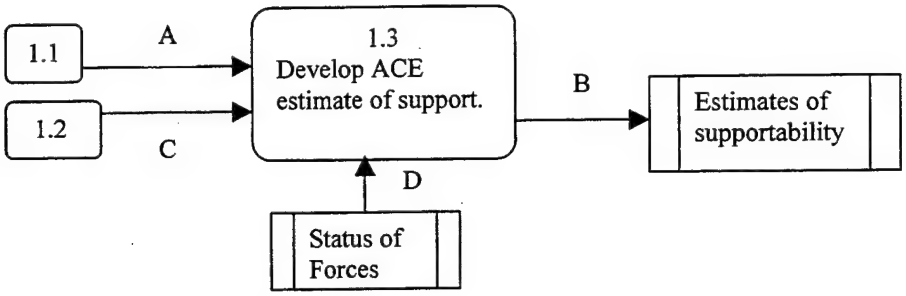
The analysis of the MEF's Future Mission Plan comes from process 1.1 via standard reports, briefs, memos and verbal messages.

This process also gets information regarding the status of forces. Currently this information is provided via phone calls, faxes, some integrated databases, and daily reports. The status of forces information is obtained by coordinating with the resource providers who manage the assets employed by the ACE (aircraft, pilots, support equipment). The resource providers maintain the status of their respective assets and store this information in the status of forces data store.

9. **What is the current status of the process?**
Developing COA's is a complex process that is not readily suitable for intranet-based technology. However, the status of forces information is a good candidate. From observations during the MEF-EX and study of the typical reports used by the ACE, the status of forces information is produced by standalone word processors and posted on white boards or clipboards.

10. **Which C4I systems support this process?**
The Intelligence Analysis System (IAS) provides the latest intelligence information on the enemy. The Tactical Combat Operation (TCO) provides the latest information on friendly unit locations. The GCCS provides some status of forces information, as does CTAPS. The Rapid Application of Air Power (RAAP) is used extensively for developing the COA's for the ACE.

Process – 1.3



Data Flows:
A – Future MEF Mission Plan and MEF Guidance
B – Estimates of Supportability
C – Course of Action
D - Current Status of Forces

Process 1.3 Description: This process receives the MEF's requirements for its Future Mission Plan and the current intelligence information. This process involves conducting an initial analysis of the MEF's requirements in preparation for developing possible courses of action for the ACE Commander to review.

1. **What entities does this process affect?**
   ACE Aviation Plan
   ACE Estimate of Supportability
   Future Plans Directorate
   MEF Future Mission Plan
   Status of Forces

2. **How many users does this process have?**
   All 18 Marines in the Future Plans Directorate will be working in this process.

3. **Who is the primary owner of this process?**
   The Director of Future Plans/Strategy Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is normally conducted whenever the MEF forwards its future mission plan. Normally this would be done every two or three days, possibly as often as every day.

5. **How often is this process updated?**
   The process is updated on a daily basis, since the status of forces information changes daily

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   All of the information is classified and the volume will normally be low to medium.

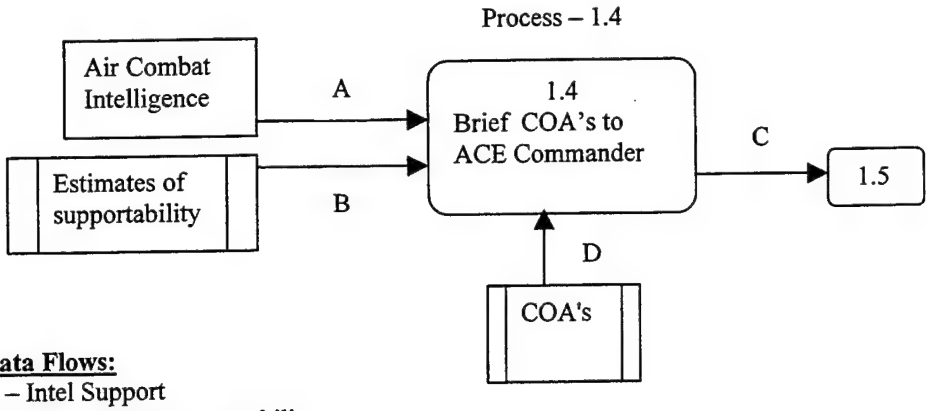
8. **What is the source of information for this process?**
   The analysis of the MEF's Future Mission Plan comes from process 1.1 via standard reports, briefs, memos and verbal messages.

The COAs come from process 1.2.

This process also gets information regarding the status of forces. Currently this information is provided via phone calls, faxes, some integrated databases, and daily reports. The status of forces information is obtained by coordinating with the resource providers who manage the assets employed by the ACE (aircraft, pilots, support equipment). The resource providers maintain the status of their respective assets and store this information in the status of forces data store.

9. **What is the current status of the process?**
The process of developing estimates of supportability is a collaborative effort for the Future Plans Directorate. The status of forces information is a strong candidate for intranet-based technology. Most of the information is partly automated through the use of standard reports from word processors, faxed in reports, message traffic, and email that are collected by the members of the Future Plans Directorate. The status of forces information is posted on centrally located white boards and clipboards within Future Plans.

10. **Which C4I systems support this process?**
The Tactical Combat Operation (TCO) provides the latest information on friendly unit locations. The GCCS provides some status of forces information, as does CTAPS.



Data Flows:
A – Intel Support
B – Estimates of Supportability
C – Courses of Action Briefs
D– Courses of Action Information

Process 1.4 Description: This process involves briefing the ACE Commander on the various COAs that have been developed in response to the requirements of the MEF. The briefing includes the latest intelligence information and the ACE's estimate of supportability for the COAs.

1. **What entities does this process affect?**
   ACE Aviation Plan
   ACE Commander and key staff
   ACE Estimate of Supportability
   Future Plans Directorate
   MEF Future Mission Plan
   Status of Forces

2. **How many users does this process have?**
   The ACE Commander and his key staff as well as the members of the Future Plans Directorate who participate in the brief.

3. **Who is the primary owner of this process?**
   The Director of Future Plans/Strategy Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is normally conducted whenever a decision from the ACE Commander is needed regarding the COA to pursue. Normally this would be done every two or three days, possibly as often as every day.

5. **How often is this process updated?**
   The process is updated as needed in preparation for the brief to the ACE Commander.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   All of the information is customized for the ACE Commander and his staff based on what they need to know and what they like to see. Most of the information is classified and the volume of information will normally be low to medium.

8. **What is the source of information for this process?**
The COAs are retrieved from the COA data store after being developed in process 1.2.

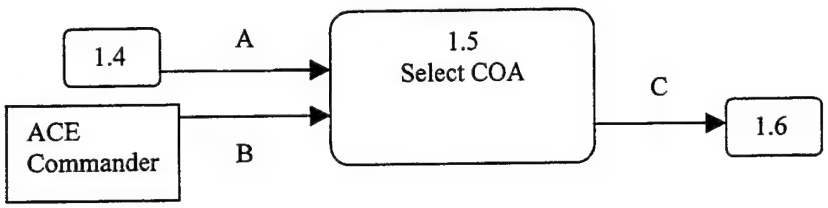
The estimates of information are retrieved from their data store after being developed in process 1.3.

Intelligence support information comes from database queries (IAS), briefings from intelligence personnel, and standard intelligence reports.

9. **What is the current status of the process?**
The process of developing estimates of supportability is a collaborative effort for the Future Plans Directorate. All members participate in developing the COA brief for the ACE Commander. The process is partly automated through the use of presentation applications. The process is not currently on any Intranet.

10. **Which C4I systems support this process?**
The Tactical Combat Operation (TCO) is available to the ACE Commander to provide the latest information on friendly unit locations. The IAS provides the latest Intelligence information and the GCCS provides some status of forces information.

Process – 1.5



Data Flows:
A – COA Briefing information
B – ACE Commander Input
C – Selected COA

Process 1.5 Description: During this process the ACE Commander selects his choice of COA for the Future Plans Directorate to develop. The result of this process is turned into the ACE's detailed plan to support the MEF's future mission plan.

1. **What entities does this process affect?**
   ACE Aviation Plan
   ACE Commander and key staff
   ACE Estimate of Supportability
   Future Plans Directorate
   MEF Future Mission Plan
   Status of Forces

2. **How many users does this process have?**
   The ACE Commander.

3. **Who is the primary owner of this process?**
   The Director of Future Plans/Strategy Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is normally conducted whenever a decision from the ACE Commander is needed regarding the COA to pursue. Normally this would be done every two or three days, possibly as often as every day.

5. **How often is this process updated?**
   The process is updated as needed following the results of the brief to the ACE Commander.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

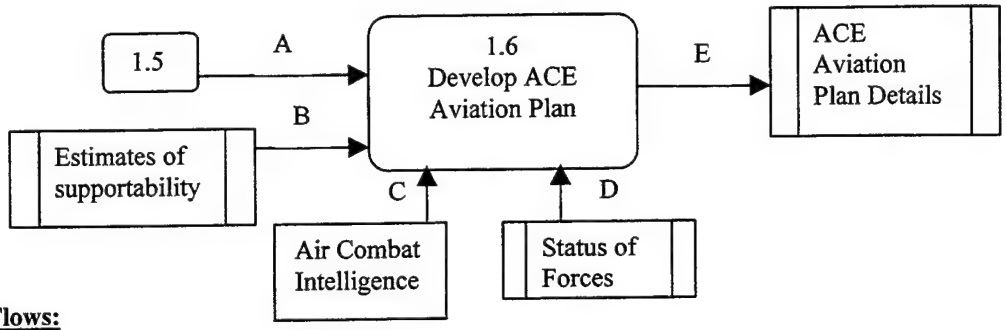
7. **What type of information does this process use?**
   All of the information is customized for the ACE Commander and his staff based on what they need to know and what they like to see. Most of the information is classified and the volume of information will normally be low to medium.

8. **What is the source of information for this process?**
   The COAs are retrieved from process 1.4. The ACE Commander provides his inputs in the form of weight of effort, rules of engagement, apportionment considerations, sortie rates.

9. **What is the current status of the process?**
The process of selecting a COA is straightforward and uses some manual and partly automated operations (verbal orders, some email). The process is not currently on the ACE Intranet.

10. **Which C4I systems support this process?**
The Tactical Combat Operation (TCO) is available to the ACE Commander to provide the latest information on friendly unit locations. The IAS provides the latest Intelligence information and the GCCS provides some status of forces information.

Process – 1.6



Data Flows:
A – ACE Commander Decision and Guidance
B – Estimates of Supportability
C – Intelligence Support
D – Status of Forces information
E – ACE Plan Details

Process 1.6 Description: During this process the Future Plans Directorate gets to work and develops and refines the details for the ACE Aviation Plan to support the MEF's Future Mission Plan. The Future Plans Directorate accesses the latest intelligence information, the latest status of forces, and reviews the estimates of supportability. The result of this process is turned into the ACE's Aviation plan to support the MEF's future mission plan. The Aviation Plan will then be turned over to the Future Operations Directorate to turn into an Air Tasking Order .

1. **What entities does this process affect?**
   ACE Aviation Plan
   ACE Estimate of Supportability
   Future Operations Directorate
   Future Plans Directorate
   MEF Future Mission Plan
   Resource Providers
   Status of Forces

2. **How many users does this process have?**
   All 18 members of the Future Plans Directorate.

3. **Who is the primary owner of this process?**
   The Director of Future Plans/Strategy Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is normally conducted whenever the ACE needs to develop or refine a new Aviation Plan. Normally this would be done every two or three days, possibly as often as every day.

5. **How often is this process updated?**
   The process is updated based on the ACE Commander's decision.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**

This process uses a wide variety of information types. Most of the information is classified and the volume of information will be medium to high

8. **What is the source of information for this process?**
The selected COA and ACE Commanders guidance is input from process 1.5.
The current intelligence information is provided from queries of the IAS, and standard intelligence reports and intelligence briefs.
The estimates of supportability and status of forces are retrieved from their respective data stores.

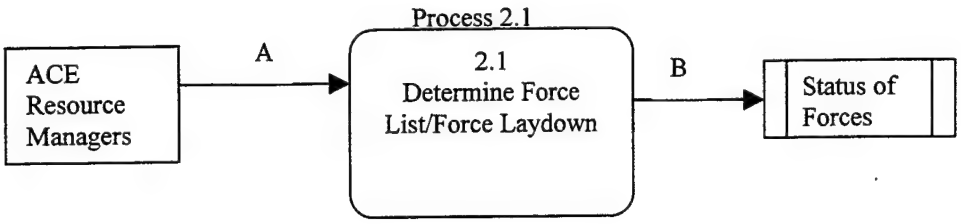
9. **What is the current status of the process?**
This is a complex and detailed process with a lot of moving parts. Very little of this process is on the Intranet. Much of this process is still manual and partly automated. The members of the Future Plans Directorate do a great deal of this process with pen and paper.

The estimates of supportability are partly automated and the information is retrieved from the standalone databases. Some of the estimates of supportability information are still manual and must be retrieved from folders or off the whiteboard or clipboards in Future Plans.
Some of the status of forces information is partly automated and some is still manual. The information is retrieved from the databases or taken off the whiteboard or clipboard that are maintained in Future Plans.

10. **Which C4I systems support this process?**
The Tactical Combat Operation (TCO) is available to provide the latest information on friendly unit locations. The IAS provides the latest Intelligence information and the GCCS provides some status of forces information. CTAPS is used extensively to develop the ACE's Aviation Plan.

Process 2.0 Data Flows

A – Squadron Input
B – Updated Asset information
C – Critical Resource Information by Airfield
D – Squadron Aircraft Availability
E – Squadron Aircrew Availability
F – Status of Forces Update
G – Critical Resource Availability by Airfield
H – Critical Resource Usage
I – Projected Squadron Sortie Rate
J – Squadron Sortie Rate History
K – Projected Critical Resource Utilization Rate



Data Flows:
A – Asset update information
B – Updated asset information

Process 2.1 Description: This process keeps track of the current force list for the ACE. The force list provides information about the types of assets and resources that are currently available to the ACE. The information developed from this process is stored in the status of forces data store.

1. **What entities does this process affect?**
   Force List
   ACE Resource Managers
   Status of Forces

2. **How many users does this process have?**
   This process is accessed by the Future Plans, Future Operations, and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   It is not clear who is the primary owner since each of the Directorates uses this process. Future Plans probably uses this process the most.

4. **How often is this process used?**
   This process is executed whenever there are changes to the force list. This process should not happen too often after all of the forces have arrived in theater.

5. **How often is this process updated?**
   Same as above.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses single updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be low.

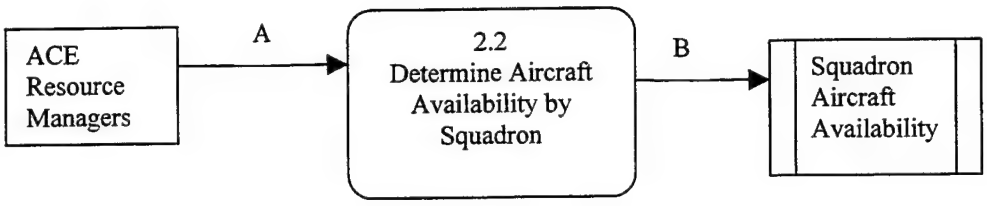
8. **What is the source of information for this process?**
   The ACE resource managers are responsible for reporting the information as it changes.

9. **What is the current status of the process?**
   Very little of this process is on the ACE Intranet. Most of this information is available on databases in GCCS and TCO. However, the three Directorates all post this information on whiteboards or wall maps since GCCS and TCO terminals are not always available.

10. **Which C4I systems support this process?**

TCO provides the common operational picture that shows the force list. GCCS provides information that would contain the force list.

Process – 2.2



Data Flows:
A – Squadron inputs
B – Aircraft availability by squadron

Process 2.2 Description: This process keeps track of the current aircraft availability for the ACE. The ACE resource managers (squadrons in this case) submit the status of their aircraft. This information is processed and stored in the squadron aircraft availability data store which will be used by process 2.4 to determine the number of sorties each squadron can support.

1. **What entities does this process affect?**
   ACE Resource Managers
   Squadrons
   Sorties
   Aircraft
   Status of Forces

2. **How many users does this process have?**
   This process is accessed by the Future Plans, Future Operations, and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   It is not clear who is the primary owner since each of the Directorates uses this process. Future Plans probably uses this process the most.

4. **How often is this process used?**
   This process is executed on a daily basis, and sometimes more frequently. As the status of any aircraft changes, the squadron will report that information to the process.

5. **How often is this process updated?**
   Same as above.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is unclassified but sensitive and customized and the volume of information will be low.

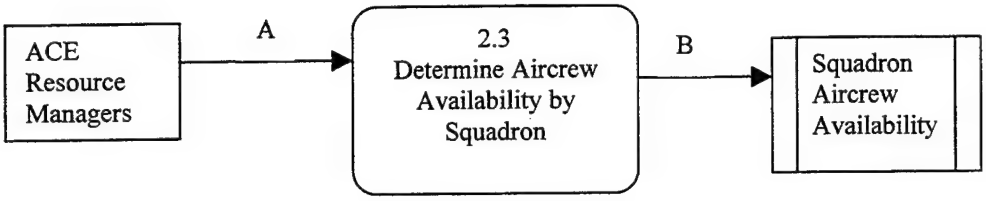
8. **What is the source of information for this process?**
   The ACE resource managers are responsible for reporting the information as it changes.

9. **What is the current status of the process?**
   This process is not currently on the ACE Intranet. This information is available on databases of systems that are not directly available to the three Directorates. CTAPS has the ability to partially

support this process, but CTAPS is not usually found at the ACE Resource Manager level so there is no way for the information to be entered. The three Directorates all post this information on whiteboards or wall maps since it is vital to their missions.

10. **Which C4I systems support this process?**
CTAPS provides the capability but it does not appear to be used.

Process – 2.3



Data Flows:
A – Squadron inputs
B – Aircrew availability by squadron

Process 2.3 Description: This process keeps track of the current aircrew availability for the ACE. The ACE resource managers (squadrons in this case) submit the status of their aircrew. This information is processed and stored in the squadron aircrew availability data store which will be used by process 2.4 to determine the number of sorties each squadron can support.

1. **What entities does this process affect?**
   ACE Resource Managers
   Squadrons
   Sorties
   Aircrew
   Status of Forces

2. **How many users does this process have?**
   This process is accessed by the Future Plans, Future Operations, and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   It is not clear who is the primary owner since each of the Directorates uses this process. Future Plans probably uses this process the most.

4. **How often is this process used?**
   This process is executed on a daily basis, and sometimes more frequently. As the status of squadron aircrew changes, the squadron will report that information to the process.

5. **How often is this process updated?**
   Same as above.

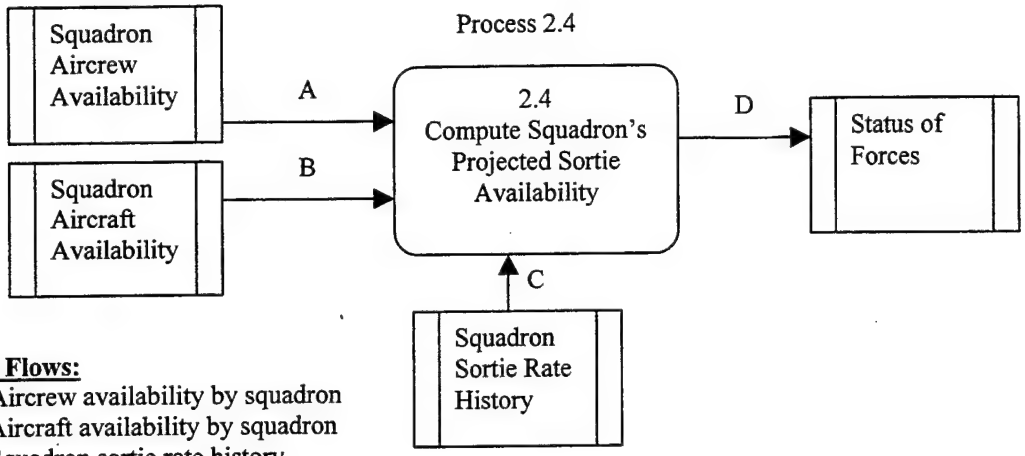
6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is unclassified but sensitive and customized and the volume of information will be low.

8. **What is the source of information for this process?**
   The ACE resource managers are responsible for reporting the information as it changes.

9. **What is the current status of the process?**
This process is currently not on the ACE Intranet. This information is available on databases of systems that are not directly available to the three Directorates. CTAPS has the ability to partially support this process, but CTAPS is not usually found at the ACE Resource Manager level so there is no way for the information to be entered. The three Directorates all post this information on whiteboards or wall maps since it is vital to their missions.

10. **Which C4I systems support this process?**
CTAPS provides a limited capability but it does not appear to be used.



Data Flows:
A – Aircrew availability by squadron
B – Aircraft availability by squadron
C – Squadron sortie rate history
D – Projected Squadron sortie rates

Process 2.4 Description: This process computes the sortie rates each squadron should be able to generate based on that squadron's aircraft and aircrew availability. The process will compute two sortie rates, a sustained rate for normal operations and a surge rate for limited duration, high intensity operations. These two sorties rates will be stored in the status of forces data store.

1. **What entities does this process affect?**
   ACE Resource Managers
   Squadrons
   Sorties
   Sortie Rates
   Aircraft
   Aircrew
   Status of Forces

2. **How many users does this process have?**
   This process is accessed by the Future Plans, Future Operations, and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   It is not clear who is the primary owner since each of the Directorates uses this process. Future Plans probably uses this process the most.

4. **How often is this process used?**
   This process is executed on a daily basis. This process is used by each of the three Directorates on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever squadron aircraft or squadron aircrew availability is adjusted.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**

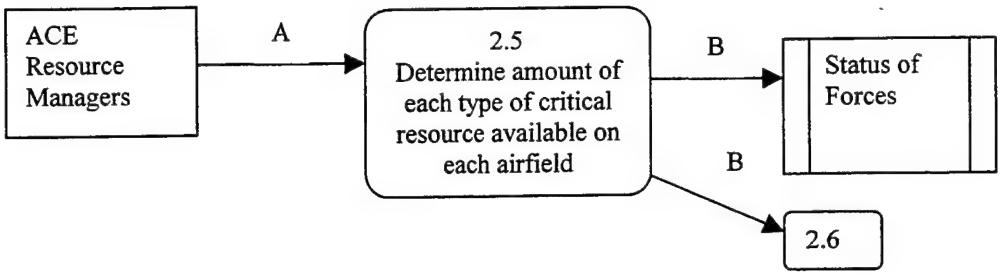
Most of the information is unclassified but sensitive and customized and the volume of information will be low.

8. **What is the source of information for this process?**
The ACE resource managers are responsible for reporting the aircraft and aircrew availability as it changes.

9. **What is the current status of the process?**
This process is not on the Intranet. The database in CTAPS has the ability to partially support this process, but CTAPS is not usually found at the ACE Resource Manager level so there is no way for the information to be entered. The three Directorates all post this information on whiteboards or wall maps since it is vital to their missions.

10. **Which C4I systems support this process?**
CTAPS provides a limited capability but it does not appear to be widely used.

Process – 2.5



Data Flows:
A – Critical resource information by airfield
B – Critical resource availability by airfield

Process 2.5 Description: This process computes the amount of each critical resource available at each airfield and forwards the information to the status of forces data store. This information is also passed on process 2.6 which will determine the utilization rate of each critical resource.

1. **What entities does this process affect?**
   ACE Resource Managers
   Critical Resources
   Status of Forces

2. **How many users does this process have?**
   This process is accessed by the Future Plans, Future Operations, and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   It is not clear who is the primary owner since each of the Directorates uses this process. Future Plans probably uses this process the most.

4. **How often is this process used?**
   This process is executed on a daily basis. This process is used by each of the three Directorates on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever the ACE resource managers update the information to the process.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is unclassified but sensitive and customized and the volume of information will be low.

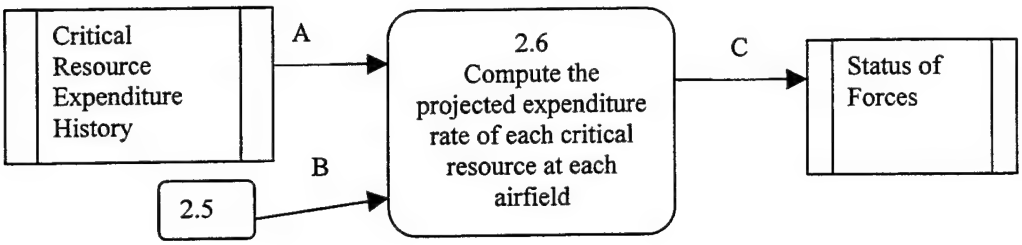
8. **What is the source of information for this process?**
   The ACE resource managers are responsible for periodically reporting the status of their critical resources.

9. **What is the current status of the process?**

This process is currently not on the ACE Intranet. The database in CTAPS has the ability to partially support this process, but CTAPS is not usually found at the ACE Resource Manager level so there is no way for the information to be entered. The three Directorates all post this information on whiteboards or wall maps since it is vital to their missions.

10. **Which C4I systems support this process?**
CTAPS provides a very limited capability but it does not appear to be widely used.

Process – 2.6



Data Flows:
A – Critical resource usage
B – Critical resource availability by airfield
C – Projected critical resource utilization rate

Process 2.6 Description: This process receives the amount of each critical resource currently available from each airfield, the usage history of that critical resource and then computes the projected utilization rate of each critical resource at each airfield and forwards the information to the status of forces data store.

1. **What entities does this process affect?**
   ACE Resource Managers
   Critical Resources
   Critical Resources Utilization Rate
   Critical Resources Usage History
   Status of Forces

2. **How many users does this process have?**
   This process is accessed by the Future Plans, Future Operations, and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   It is not clear who is the primary owner since each of the Directorates uses this process. Future Plans probably uses this process the most.

4. **How often is this process used?**
   This process is executed on a daily basis. This process is used by each of the three Directorates on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever the ACE resource managers update the information to the process.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is unclassified but sensitive and customized and the volume of information will be low.

8. **What is the source of information for this process?**

The ACE resource managers are responsible for periodically reporting the status of their critical resources.

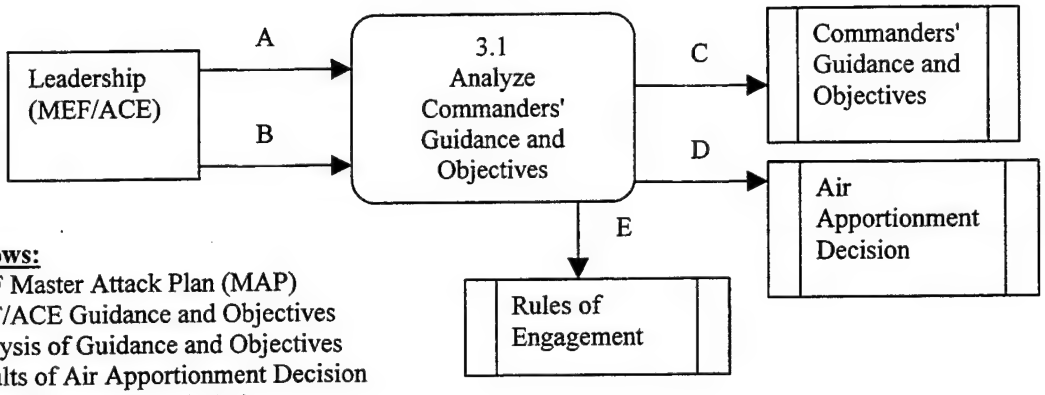
9. **What is the current status of the process?**
This process is currently not on the ACE Intranet. The database in CTAPS has the ability to partially support this process, but CTAPS is not usually found at the ACE Resource Manager level so there is no way for the information to be entered. The three Directorates all post this information on whiteboards or wall maps since it is vital to their missions.

10. **Which C4I systems support this process?**
CTAPS provides a very limited capability but it does not appear to be widely used.

Process 3.0 Data flows

A – Leadership Guidance and Objectives
B – Rules of Engagement
C – Analysis of Guidance and Objectives
D – Air Apportionment Decision
E – Aviation Plan
F – ATO Results
G – Analysis of Aviation Plan
H – ATO results
I – Intelligence Support
J – MEF Plans and Guidance
K – Status of Forces
L – Frag Order
M – Next ATO

Process – 3.1



Data Flows:
A – MEF Master Attack Plan (MAP)
B – MEF/ACE Guidance and Objectives
C – Analysis of Guidance and Objectives
D – Results of Air Apportionment Decision
E – Rules of Engagement (ROE)

Process 3.1 Description: This process receives the guidance and objectives that the MEF and ACE Commander have established for the next ATO cycle. Included in the MEF/ACE guidance is the air apportionment decision which determines what percent of the available sorties the ACE will provide to Close Air Support missions and Airborne Interdiction missions. The process may also provide new or updated Rules of Engagement that will be incorporated into the next ATO cycle. The MEF/ACE Commanders' Guidance and objectives may include specifics on targeting guidance, targeting objectives, fire support coordination measures and weight of effort.

1. **What entities does this process affect?**
   ATO
   ROE
   Air Apportionment Decision
   Future Operations Directorate

2. **How many users does this process have?**
   This process is accessed by the Future Operations Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

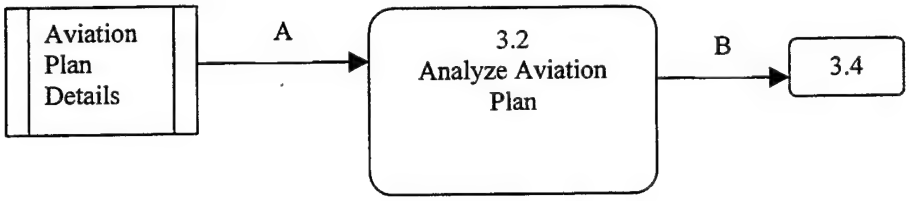
8. **What is the source of information for this process?**

The leadership (MEF and ACE) Commanders provide their inputs to the process and serve as the source of information. Their inputs can be provided as verbal orders, written memos or orders, email, or message traffic.

9. **What is the current status of the process?**
The database in CTAPS has the ability to partially support information on ROE, targeting objectives, and targeting guidance and the air apportionment decision. However, the current process does not utilize CTAPS for any of these roles. Most of this information for this process is partly automated and posted in folders or on a white board in the Future Operations working area.

10. **Which C4I systems support this process?**
CTAPS provides a limited capability but it does not appear to be widely used. GCCS could also be used to support the process of maintaining and analyzing the guidance and objectives of the MEF and ACE Commanders.

Process – 3.2



Data Flows:
A – Aviation Plan Details
B – Analysis of Aviation Plan

Process 3.2 Description: This process analyzes the Aviation Plan developed by the Future Plans Directorate during process 1.0. The results of this process will be used to develop the next Air Tasking Order.

1. **What entities does this process affect?**
   Aviation Plan
   ATO
   Future Operations Directorate

2. **How many users does this process have?**
   This process is accessed by the Future Operations Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

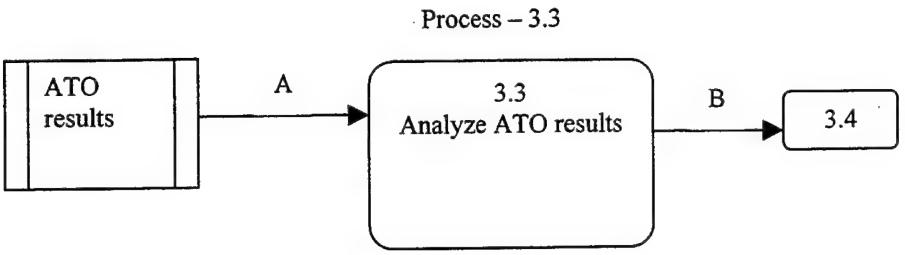
6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   The source of this process comes from the Aviation Plan developed by the Future Plans Directorate. The Aviation Plan is normally contained on briefing slides and folders, along with printed reports, email and message traffic to support it.

9. **What is the current status of the process?**
   This process is partly automated since the Aviation Plan will probably be stored on briefing slides. The CTAPS database will also support part of this process.

10. **Which C4I systems support this process?**
CTAPS provides a very good capability to support this process but it does not appear to be widely used the ACE..



Data Flows:
A – ATO results information
B – Analysis of ATO results

Process 3.3 Description: This process analyzes the results of previous ATOs and provides that information to the process that develops the next ATO..

1. **What entities does this process affect?**
   ATO
   ATO results
   Future Operations Directorate

2. **How many users does this process have?**
   This process is accessed by the Future Operations Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes and whenever new ATO results become available.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

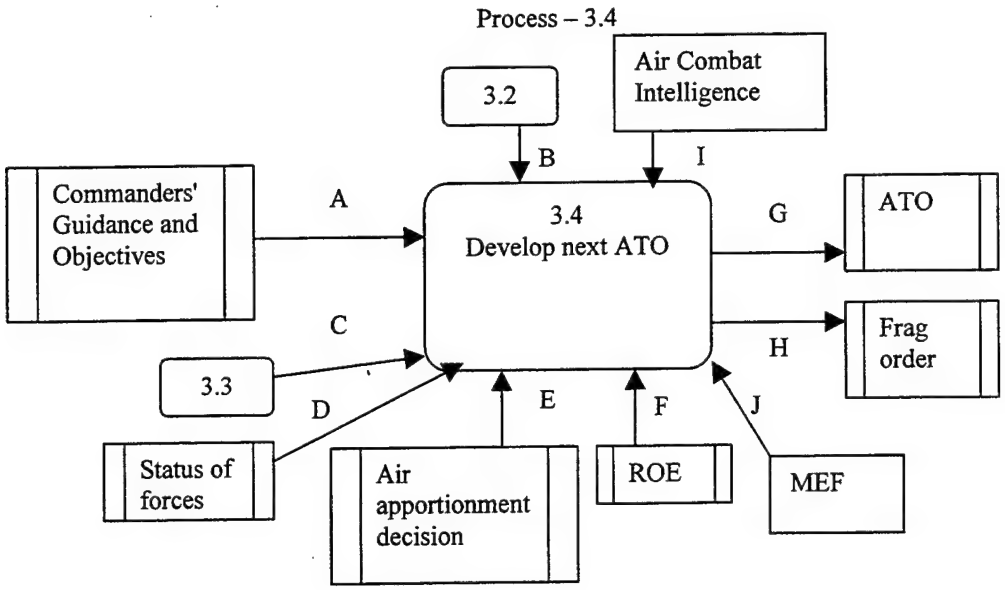
7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   The source of this process comes from the ATO results produced in process 6.0. This information is found in printed reports, standard reports from databases and memos and debrief forms.

9. **What is the current status of the process?**
   This process is not currently available on the ACE Intranet. This process is fairly well automated since the ATO results are stored in several databases. However, it is uncertain how accessible the information is to the Marines in the Future Operations Directorate who need it.

10. Which C4I systems support this process?

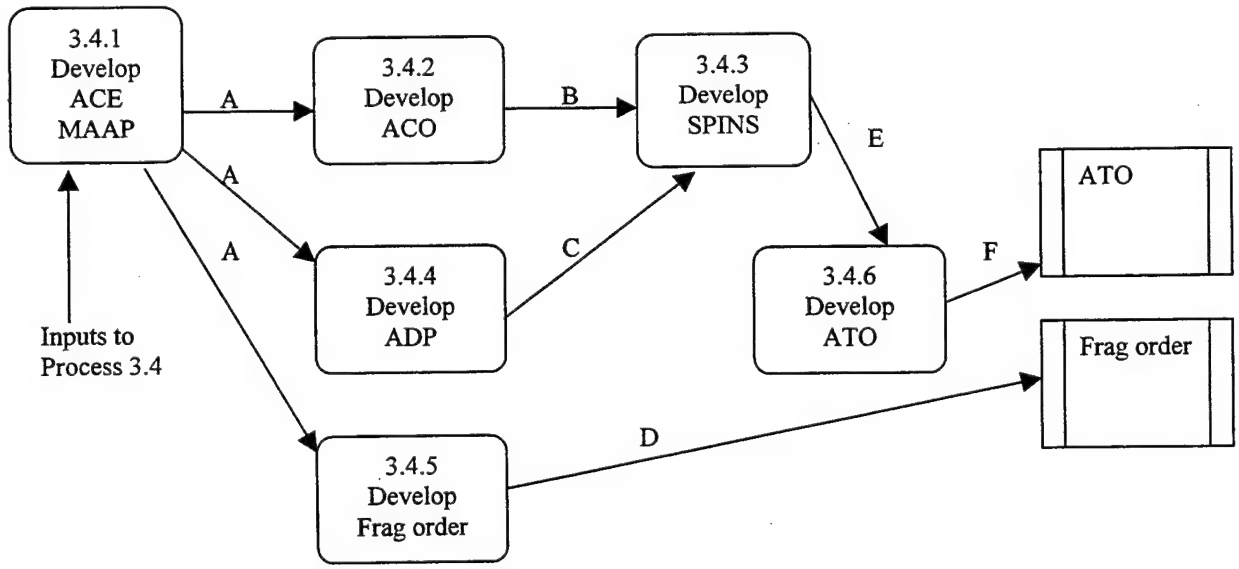
CTAPS provides a very good capability to support this process but this capability does not appear to be widely used in the ACE..



Data Flows:

A – Analysis of Guidance and Objectives
B – Analysis of Aviation Plan
C – Analysis of ATO results
D – Status of forces information
E – Results of Air Apportionment Decision
F – Rules of Engagement (ROE)
G – Next ATO
H – Next Frag order
I – Intelligence Support
J – Updates to MEF's MAP

Process 3.4 exploded



Data Flows:
A – ACE Master Air Attack Plan
B – Airspace Control Order based on ATO
C – Air Defense Plan based on ATO
D – Next Frag order
E – Special Instructions based on MAAP, ACO and ADP
F – Next ATO

Process 3.4 Description: This process is the heart of the whole ATO development process. This process takes the Commanders' Guidance and objectives, the analysis of previous ATOs, the current Aviation Plan put together by the Future Plans Directorate, the new or modified ROE, the current status of forces information, any updates to the MEF Master Attack Plan (MAP) and the air apportionment decision and produces the ATO. Before the ATO is finalized the Future Operations Directorate produces the ACE Master Air Attack Plan (MAAP). Also included in this process as seen when it is exploded is the production of the Airspace Control Order (ACO), the Air Defense Plan (ADP), and the Special Instructions (SPINS). The ACO, ADP and SPINS are produced after the MAAP and are all published in the ATO when it is disseminated to the ACE resource managers. This process also produces the Frag order which gives the Future Operations Directorate a means to give the ACE Resource Managers a heads up for what will be required of them during the next ATO.

1. **What entities does this process affect?**
   ATO
   ACP
   ADP
   SPINS
   ATO results
   Future Operations Directorate
   Aviation Plan
   ROE
   Frag order
   Air Apportionment Decision
   MEF MAP
   Status of forces

2. **How many users does this process have?**
   This process is accessed by the Future Operations Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   There are several sources of information for this process. The Commanders' Guidance and objectives, ROE, and Air Apportionment decision come from memos, email, orders, or message traffic. The status of forces information is pulled from queries on several databases or from standard reports submitted by the ACE resource managers. The source of the ATO results information is produced in process 6.0 and is in the form of printed reports, standard reports from databases, memos and debrief forms. The source of information for the Aviation Plan is the CTAPS database and briefing slides, memo, and reports that the Future Plans Directorate used to develop the Aviation Plan. The MEF Master Attack Plan is a printed form that lists the MEF's targets and designates the asset assigned to the target (air, naval gunfire, etc.,).

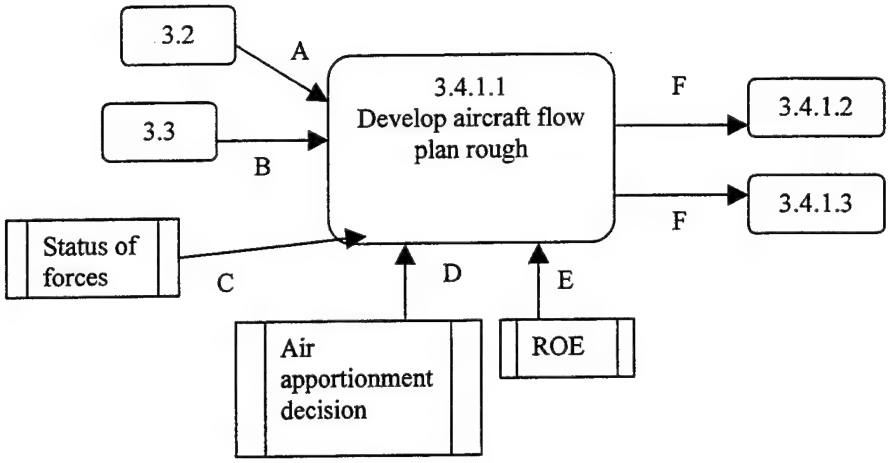
9. **What is the current status of the process?**
   This process is not currently available on the ACE Intranet. This process is fairly well automated since much of this information is stored in several CTAPS databases. The development of the frag order is not as well automated since it is a function that really falls outside of CTAPS. The frag order must be produced with a word processing application and released as a message, or written order, or possibly an email to the ACE resource managers.

10. **Which C4I systems support this process?**
    This process is the primary reason for having CTAPS. CTAPS takes all of the inputs for this process and helps the CTAPS user develop a plan that meets the requirements. CTAPS automatically generates the ATO as a results of this process.

Process 3.4.1 Data Flows

A – Rules of Engagement
B – Air Apportionment Decision
C – Analysis of ATO Results
D – Analysis of Aviation Plan
E – Status of Forces
F – Aircraft Flow Plan
G – MEF Plan
H – Intelligence Support
I – Leadership Guidance
J – ACE Targets
K – Air Interdiction (AI) and Close Air Support (CAS) Missions
L – ACE Master Air Attack Plan (MAAP)

Process – 3.4.1.1 (Process 3.4.1 exploded)



Data Flows:
A – Analysis of Aviation Plan
B – Analysis of ATO results
C – Status of forces information
D – Results of Air Apportionment Decision
E – Rules of Engagement (ROE)
F – Aircraft flow plan

Process 3.4.1.1 Description: This process receives the ACE's aviation plan, the results of the previous ATO, the status of forces, the rules of engagement, and the air apportionment decision. From the inputs the process develops a flow plan for all of the aircraft that will be required to support the ATO. The flow plan includes takeoff time, mission time, land time, and maintenance turnaround time for each individual aircraft that will be needed for the ATO. The results of this process will be used by processes 3.4.1.2 and 3.4.1.3 to develop further the next ATO.

1. **What entities does this process affect?**
   ATO
   ATO results
   Future Operations Directorate
   Aviation Plan
   ROE
   Air Apportionment Decision
   Status of forces

2. **How many users does this process have?**
   This process is used by the ATO Planning Cell in the Future Operations Directorates which consists of up to 15 Marines.

3. **Who is the primary owner of this process?**
   The head of the ATO Development Section in the Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

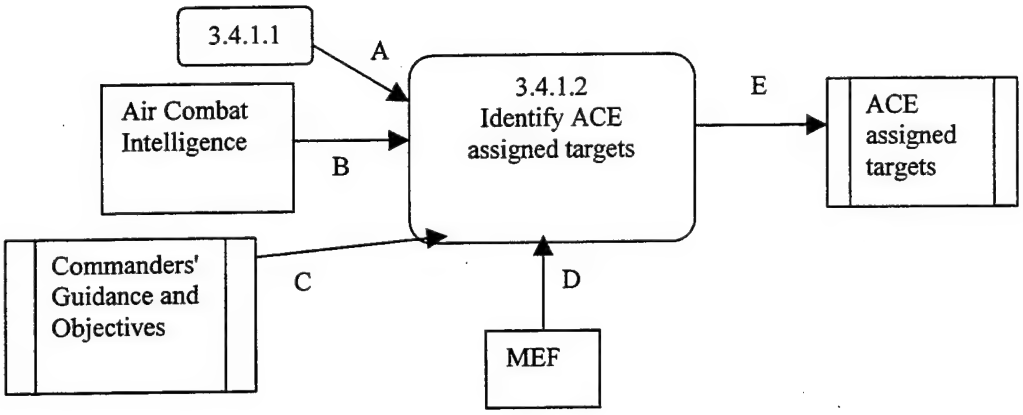
7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   There are several sources of information for this process. The ROE and Air Apportionment decision come from memos, email, orders, or message traffic. The status of forces information is pulled from queries on several databases or from standard reports submitted by the ACE resource managers. The source of the ATO results information is produced in process 6.0 and is in the form of printed reports, standard reports from databases, memos and debrief forms. The source of information for the Aviation Plan is the CTAPS database and briefing slides, memo, and reports that the Future Plans Directorate used to develop the Aviation Plan.

9. **What is the current status of the process?**
   This process is not currently available on the ACE Intranet. This process as currently used by the 3rd Marine Air Wing is almost entirely done manually by the ATO Planning cell members. Each of the planners (strike, electronic warfare, support, air defense, and air support) sits down with pencil and uses a preformatted form to plot the flow of individual aircraft and equipment over the 24 hour ATO cycle. In conversations with Marines and others who are familiar with CTAPS, they point out that CTAPS is fully capable of automating this task.

10. **Which C4I systems support this process?**
    This process is the primary reason for having CTAPS even though the Marines in 3rd MAW appear reluctant to utilize it. Most of this reluctance is due to the daunting nature of having to learn how to fully utilize the capabilities of CTAPS. Currently, the ATO Planning Cell, which is made up of officers who are well versed in tactics and aircraft capabilities, do the work by hand and then turn over their results to enlisted Marines in the ATO Production Cell who then manually reenter the information into CTAPS.

Process – 3.4.1.2 (Process 3.4.1 exploded)



Data Flows:
A – Aircraft flow plan
B – Intelligence support
C – Commanders' Guidance and Objectives
D – Updates to MEF's Master Attack Plan
E – ACE assigned targets

Process 3.4.1.2 Description: This process receives the latest intelligence information on the targets that were listed in the Aviation Plan, the current Commanders' guidance and objectives, any updates to the MEF's MAP, and the aircraft flow plan. This process generates targets that will be assigned to the ACE during the next ATO. The list of ACE assigned targets is kept in a data store.

1. **What entities does this process affect?**
   ATO
   Aircraft flow plan
   Intelligence
   Future Operations Directorate
   Aviation Plan
   MEF MAP

2. **How many users does this process have?**
   This process is used by the ATO Planning Cell in the Future Operations Directorates which consists of up to 15 Marines.

3. **Who is the primary owner of this process?**
   The head of the ATO Development Section in the Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

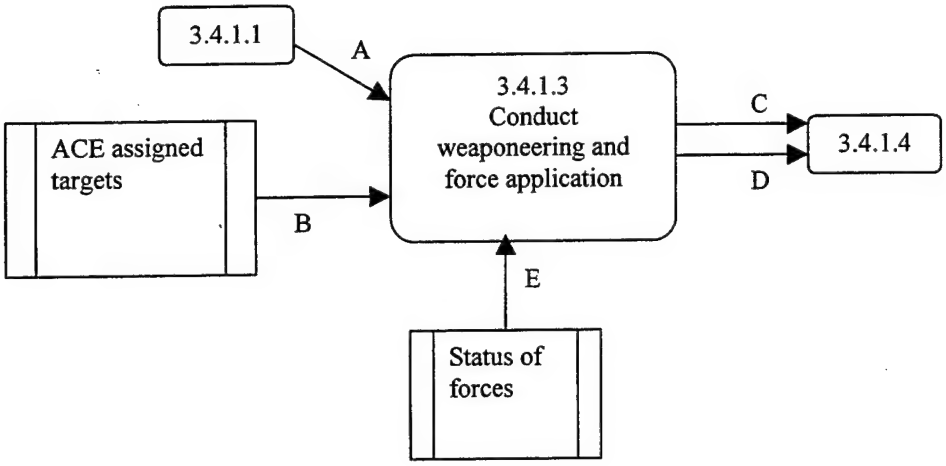
7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   There are several sources of information for this process. The latest intelligence information is provided by database queries of the IAS, as well as printed reports and verbal briefs provided by ACI. The current Commanders' guidance and objectives are pulled from memos, emails, briefings, message traffic that are stored in files or folders. The aircraft flow plan comes from process 3.4.1.1. in the form of a handwritten preformatted sheet. The MEF MAP is a printed list of targets with an assigned asset for that target.

9. **What is the current status of the process?**
   This process is not currently available on the ACE Intranet. This process is mostly a manual system that the ATO Planning Cell uses to identify and assign targets that the MEF has tasked for the ACE. The intelligence support is automated since target images and target status can be provided by queries of the IAS database. The ATO Planning Cell must also access the current Commanders' Guidance and objectives which are often stored on paper in a folder.

10. **Which C4I systems support this process?**
    This process uses IAS extensively for the latest intelligence updates on target status.

Process – 3.4.1.3 (Process 3.4.1 exploded)



Data Flows:
A – Aircraft flow plan
B – ACE assigned target information
C – Close Air Support (CAS) missions
D – Air Interdiction (AI) missions
E – Status of forces information (aircraft sorties and ordnance availability)

Process 3.4.1.3 Description: Weaponeering assessment and force application is a very detailed process that goes beyond the scope of this research. Only the highlights of a simplified version of this process will be described here. This process receives the aircraft flow plan and the ACE assigned targets and determines the optimum mission type/aircraft/ordnance mix for each target. The desired ordnance load must be balanced against the information in the status of forces data store that lists how much of each of ordnance is available at each airfield. The ATO Planning Cell reviews the targets and aircraft flow plan (which incorporates the most current projection of sorties available) and then determines which aircraft should fly CAS or AI missions, which targets those missions will be assigned, and what ordnance load will be required for each mission. This information is entered on the Target Planning Worksheet. The AI and CAS assigned missions are passed on to process 3.4.1.4 which will develop the ACE Master Air Attack Plan which will eventually become the next ATO.

1. **What entities does this process affect?**
   ATO
   Aircraft flow plan
   Intelligence
   Future Operations Directorate
   Aviation Plan
   MEF MAP
   Status of forces

2. **How many users does this process have?**
   This process is used by the Wing Weaponeering Board and the ATO Planning Cell which consists of up to 15 Marines.

3. **Who is the primary owner of this process?**
   The head of the Director of the Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

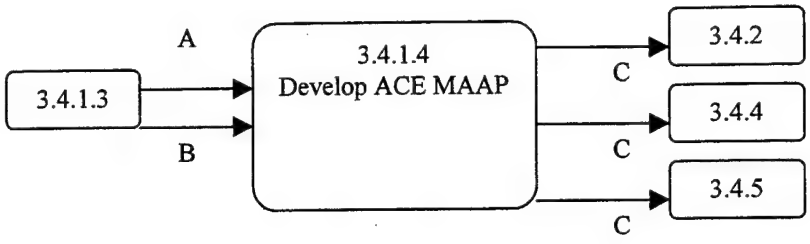
7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   There are several sources of information for this process. The target information comes from the

9. **What is the current status of the process?**
   This process is not currently available on the ACE Intranet. This process is mostly a manual system that the ATO Planning Cell uses to match aircraft, missions, and ordnance with the targets that the ACE has been assigned. The ATO Planning Cell members do most of the work themselves with the help of printed and handwritten forms list the assigned targets, the ordnance availability, and the projected sorties available to support the next ATO.

10. **Which C4I systems support this process?**
    CTAPS has the capability to support this process but it was not used by the 3rd MAW ATO Planning Cell.

Process – 3.4.1.4 (Process 3.4.1 exploded)



Data Flows:
A – Close Air Support (CAS) missions
B – Air Interdiction (AI) missions
C – ACE Master Air Attack Plan

Process 3.4.1.4 Description: The Future Operations Directorate uses this process to consolidate the AI and CAS missions into one overall plan, the ACE MAAP. The MAAP is used by the other processes in order to develop the ATO.

1. **What entities does this process affect?**
   ATO
   ACE MAAP
   Future Operations Directorate

2. **How many users does this process have?**
   This process is used by the ATO Planning Cell which consists of up to 15 Marines.

3. **Who is the primary owner of this process?**
   The head of the Director of the Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be developed.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

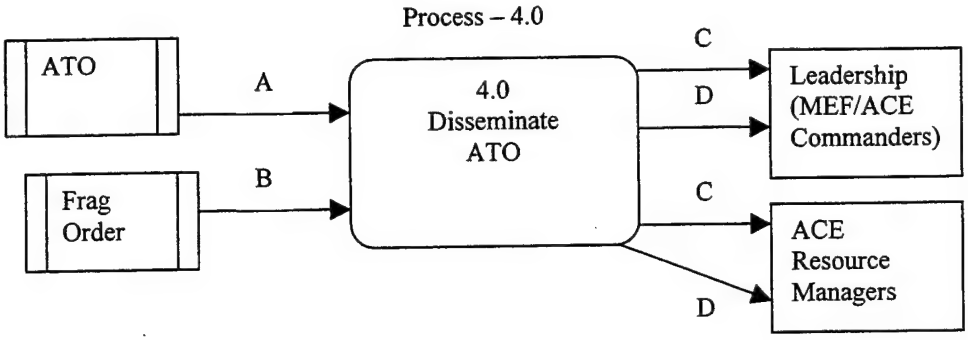
6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   There are several sources of information for this process. The target information comes from the

9. **What is the current status of the process?**
   This process is not currently available on the ACE Intranet. This process is mostly a manual system that the ATO Planning Cell uses to match aircraft, missions, and ordnance with the targets that the ACE has been assigned. The ATO Planning Cell members do most of the work themselves with the help of printed and handwritten forms list the assigned targets, the ordnance availability, and the projected sorties available to support the next ATO.

10. **Which C4I systems support this process?**
CTAPS has the capability to support this process but it was not used by the 3rd MAW ATO Planning Cell.



Data Flows:
A – ATO in final form
B – Frag Order in final form
C – Disseminated ATO
D – Disseminated Frag Order

Process 4.0 Description: This process collects the completed ATO and Frag Order and distributes these products to the Leadership and end users.

1. **What entities does this process affect?**
   ATO
   Frag order

2. **How many users does this process have?**
   This process is accessed by the Future Operations Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is responsible for this process.

4. **How often is this process used?**
   This process is executed on a daily basis or whenever a new ATO needs to be disseminated.

5. **How often is this process updated?**
   This process should be updated as the ATO cycle goes through its normal development processes.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and single queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   The ATO comes from CTAPS. The Frag order comes from printed orders or message traffic.

9. **What is the current status of the process?**
   This process is not currently on the ACE Intranet. The ATO dissemination process is totally automated as long as all parties have access to CTAPS. The dissemination of the Frag Order is automated using message traffic or order writing applications.

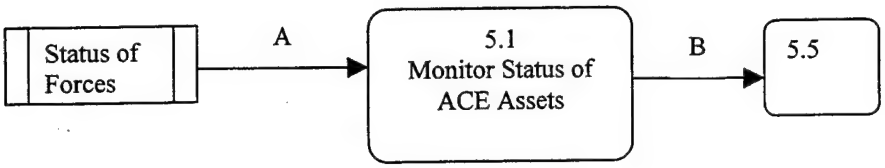
10. **Which C4I systems support this process?**

CTAPS provides an excellent capability to disseminate the ATO. The Frag order is not supported by a C4I system at this time, other than regular message traffic.

Process 5.0 Data Flows

A – Status of Forces
B – New Orders from ACE/MEF Commanders
C – Standing Commanders' Guidance
D – Rules of Engagement
E – ACE Asset Status
F – Leadership Decisions
G – Revisions to ATO
H – Current ATO Information
I – New ATO Targets
J – ATO Execution Directions
K – Intelligence Support
L – Current ATO Target Updates
M – Current ATO Targets for ACE
N – New ATO Targets

Process – 5.1



Data Flows:
A – Current Status of Forces Information
B – ACE Asset Status

Process 5.1 Description: During this process the Current Operations is executing the day's Air Tasking Order (ATO) and monitors the status and availability of all of the ACE's warfighting assets and determines their ability to execute the ATO as published. If something changes in the status of forces information this process will forward the information to process 5.5 along with a recommendation to change, delay, or delete an ATO mission.

1. **What entities does this process affect?**
   ATO
   Current Operations Directorate
   Status of Forces
   ACE Resource Managers

2. **How many users does this process have?**
   There are up to eight members of the Current Operations Watch Section that use this process.

3. **Who is the primary owner of this process?**
   The Senior Watch Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is conducted as part of the normal 24 hour ATO cycle.

5. **How often is this process updated?**
   The process is updated whenever there are changes to the status of forces information.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   This process uses customized information for each specific asset of the ACE. All of the information is classified or unclassified but sensitive. The volume of information will normally be medium.

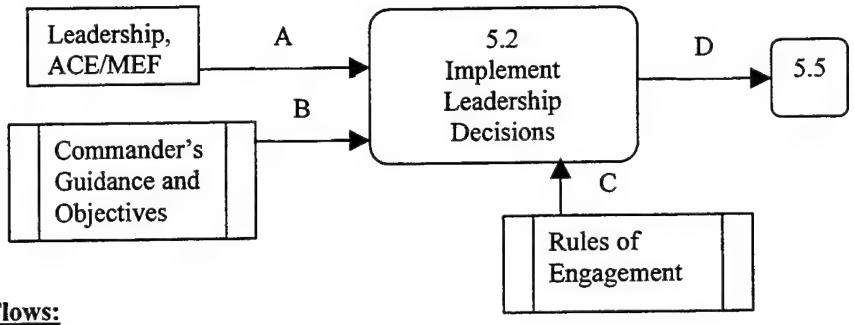
8. **What is the source of information for this process?**
   The status of forces are retrieved from their respective data stores. This information is input to the data store by the ACE resource managers who own and manage all of the warfighting assets that are required to execute the ATO.

9. **What is the current status of the process?**
   This process is not on the Intranet. Much of this process is still manual and partly automated. Some of the status of forces information can be found on linked databases, while some is maintained by

manually plotting and recording on status boards or clipboards. Updates to status of forces information may be received from phone calls, faxed reports, email, or message traffic.

10. **Which C4I systems support this process?**
The Tactical Combat Operation (TCO) is available to provide the latest information on friendly unit locations. If it is fully utilized CTAPS can provide detailed status of forces information. However, CTAPS is not widely implemented to all of the users in the ACE who would need to input their information.

Process – 5.2



Data Flows:
A – New Orders from ACE/MEF Commanders
B – Standing Commander's Guidance
C – Current Rules of Engagement
D – Leadership Decisions

Process 5.2 Description: During this process the Current Operations Directorate may receive new orders or guidance from the leadership. This process will analyze and compare the new orders with the standing orders and determine what changes need to be passed on to the current day's ATO missions.

1. **What entities does this process affect?**
   ATO
   Current Operations Directorate
   Leadership (MEF/ACE)
   Status of Forces
   ACE Resource Managers

2. **How many users does this process have?**
   There are up to eight members of the Current Operations Watch Section that use this process.

3. **Who is the primary owner of this process?**
   The Current Operations Senior Watch Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is conducted as part of the normal 24 hour ATO cycle

5. **How often is this process updated?**
   This process is updated whenever there is changes to the standing leadership guidance.

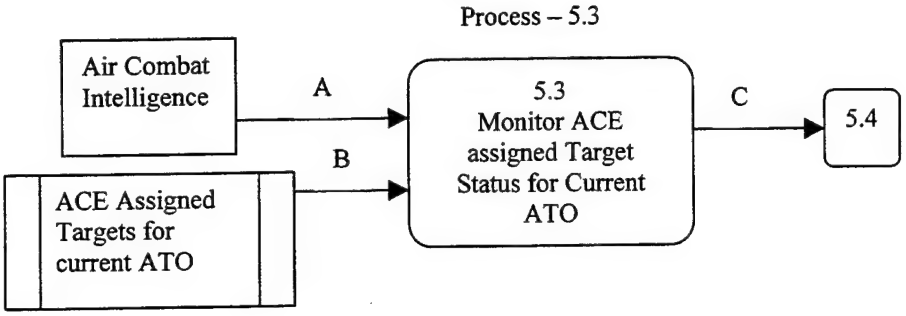
6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and the volume of information will be low.

8. **What is the source of information for this process?**
   The ROE and Commander's Guidance & Objectives are produced in separate processes and stored in their respective data stores in the form of printed reports, and messages. New orders from the leadership would be in the form of standard printed orders and message traffic.

9. **What is the current status of the process?**
   Very little of this process is on the Intranet. Much of this process is still manual and partly automated. Previous orders can be stored as a message traffic in a message database. ROE is stored in the CTAPS as part of the ATO development process.

10. **Which C4I systems support this process?**
    CTAPS provides support for ROE. There appears to be very little C4I system support to store and transmit leadership guidance for the ACE.



Data Flows:
A – Updates on status of assigned targets
B – Current ATO targets for ACE
C – Current ATO Target updates

Process 5.3 Description: During this process the Current Operations Directorate (Intelligence Watch Section) may receive updates on the status of targets assigned for the current ATO. This process will analyze and compare the target status updates with the assigned targets to determine if changes need to be made in ATO assigned targets and the current day's ATO missions.

1. **What entities does this process affect?**
   ACE Assigned Targets
   ATO
   Current Operations Directorate
   ACE Resource Managers

2. **How many users does this process have?**
   There are up to 10 members of the Current Operations Intelligence Watch Section that use this process.

3. **Who is the primary owner of this process?**
   The Current Operations Intelligence Watch Officer is the primary owner of this process.

4. **How often is this process used?**
   This process is conducted as part of the normal 24 hour ATO cycle

5. **How often is this process updated?**
   This process is updated whenever there are updates to the status of ACE assigned targets.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be medium.

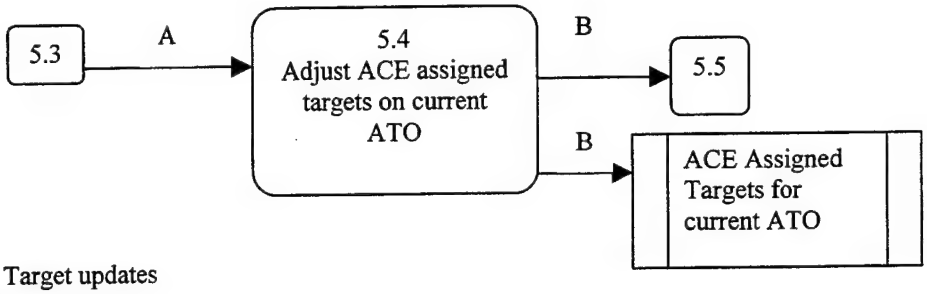
8. **What is the source of information for this process?**
   Intelligence constantly updates on the status of targets through its own systems. This information is passed to this process through the use of standard intelligence reports, email, phone calls, or verbal reports. The ACE assigned targets for the current ATO are maintained on a database (CTAPS) that are developed in a separate process .

9. **What is the current status of the process?**

Very little of this process is on the Intranet. The ACE assigned targets for the current ATO are fully automated on the CTAPS database. Updates from intelligence on target status are partly automated through word processing and database/spreadsheet applications that are not linked.

10. **Which C4I systems support this process?**
CTAPS provides support for ACE's assigned targets. There appears to be very little C4I system support to receive and transmit changes in target status from Intelligence to the Current Operations Directorate.

Process – 5.4



Data Flows:
A – Current ATO Target updates
B – New ATO targets

Process 5.4 Description: During this process the Current Operations Directorate (Intelligence Watch Section) analyzes the impact of updates to ATO assigned targets and then forwards the new targets to be included in the current ATO. This process also updates the ACE assigned targets data store.

1. **What entities does this process affect?**
   ACE Assigned Targets
   ATO
   Current Operations Directorate
   ACE Resource Managers

2. **How many users does this process have?**
   There are up to 10 members of the Current Operations Intelligence Watch Section and 8 members of the Current Operations Watch Section that share this process.

3. **Who is the primary owner of this process?**
   The Current Operations Senior Watch Officer is responsible for making changes to the current ATO and is the primary owner of this process.

4. **How often is this process used?**
   This process is routinely conducted as part of the normal 24 hour ATO cycle when changes are needed for the ATO.

5. **How often is this process updated?**
   This process is updated whenever new targets are assigned for the current ATO.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be low.

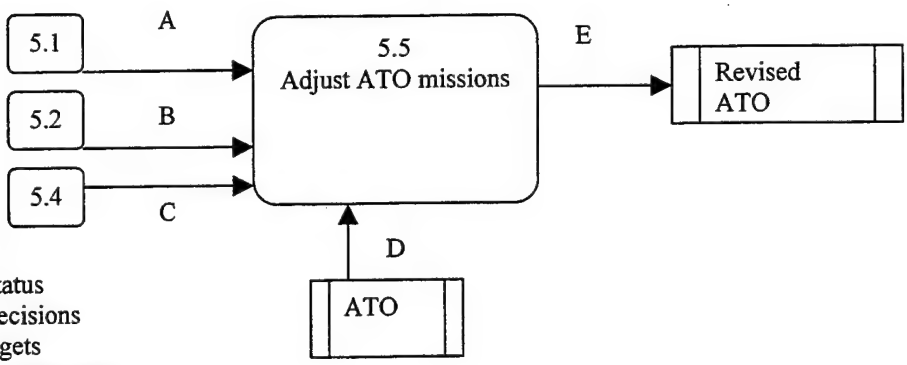
8. **What is the source of information for this process?**
   The ACE assigned targets for the current ATO are maintained on a database (CTAPS) that are developed in a separate process. Changes to the ACE assigned targets are entered into the CTAPS targets database.

9. **What is the current status of the process?**

Very little of this process is on the Intranet. Changes to the ACE assigned targets for the current ATO are fully automated on the CTAPS database. Since not everyone has access to CTAPS at all times, this information is also manually updated on the ATO "X" UPDATE USMC DIRECT SUPPORT sheet which depicts the targets assigned to each mission and limited information on new targets for each mission.

10. **Which C4I systems support this process?**
CTAPS provides support for maintaining the ACE's assigned targets. However, there appears to be very little C4I system support to post this information in an easily accessible manner for all who may need the information.

Process – 5.5



Data Flows:
A – ACE Asset Status
B – Leadership Decisions
C – New ATO targets
D – Current ATO information
E – Revisions to ATO

Process 5.5 Description: During this process the Current Operations Directorate receives the new information regarding ACE asset status, leadership decisions, and target updates and adjusts the ATO accordingly. Revisions to the ATO are published to those who need the information.

1. **What entities does this process affect?**
   ACE Assigned Targets
   ATO
   Current Operations Directorate
   ACE Resource Managers

2. **How many users does this process have?**
   This process could involve almost the entire Current Operations Directorate Watch Section (approximately 30 Marines).

3. **Who is the primary owner of this process?**
   The Current Operations Senior Watch Officer is responsible for adjusting the current ATO and is the primary owner of this process.

4. **How often is this process used?**
   This process is routinely conducted as part of the normal 24 hour ATO cycle when changes are needed to the ATO.

5. **How often is this process updated?**
   This process revises the ATO whenever changes in leadership guidance, asset status, or target status require ATO adjustment.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ.** This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be low.

8. **What is the source of information for this process?**
   The ATO stored in CTAPS is the primary source of information for this process.

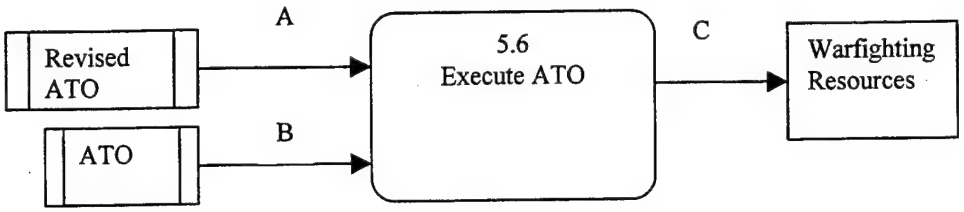
9. **What is the current status of the process?**

Very little of this process is on the Intranet. The actual changes to the ATO are fully automated on the CTAPS database. Since not everyone has access to CTAPS at all times, this information would also need to be passed by other means in the most timely manner possible (i.e., faxes, emails, phone calls, radio calls).

10. Which C4I systems support this process?

CTAPS maintains the ATO, any changes to the ATO must be entered into CTAPS. However, the limited availability of CTAPS at the unit level means there may be limited C4I system support to post this information in an easily accessible manner for all who may need the information.

Process – 5.6



Data Flows:
A – Revisions to ATO
B – Current ATO information
C – ATO execution directions

Process 5.6 Description: During this process the Current Operations Directorate consolidates the revisions to the ATO with the current ATO information and provides ATO directions to the various ACE resource managers.

1. **What entities does this process affect?**
   ATO
   Current Operations Directorate
   ACE Resource Managers

2. **How many users does this process have?**
   This process could involve almost the entire Current Operations Directorate Watch Section (approximately 30 Marines).

3. **Who is the primary owner of this process?**
   The Current Operations Senior Watch Officer is responsible for adjusting the current ATO and is the primary owner of this process.

4. **How often is this process used?**
   This process is routinely conducted as part of the normal 24 hour ATO cycle when changes are made to the ATO.

5. **How often is this process updated?**
   This process executes the ATO with or without changes to the ATO.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ.** This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be high.

8. **What is the source of information for this process?**
   The ATO stored in CTAPS is the primary source of information for this process. However, the Current Operations Directorate also uses other sources of information to execute the ATO including information received from email, faxes, reports, and phone calls.

9. **What is the current status of the process?**
   Very little of this process is on the Intranet. This process is a fast paced, time critical evolution. Much of this process relies on Marines receiving reports from various places and recording that information

on whiteboards for all members of the Current Operations Directorate to view. The ATO itself is fully automated on the CTAPS database. Since not everyone has access to CTAPS at all times, information related to the execution of the ATO would also need to be passed by other means in the most timely manner possible (i.e., faxes, emails, phone calls, radio calls).

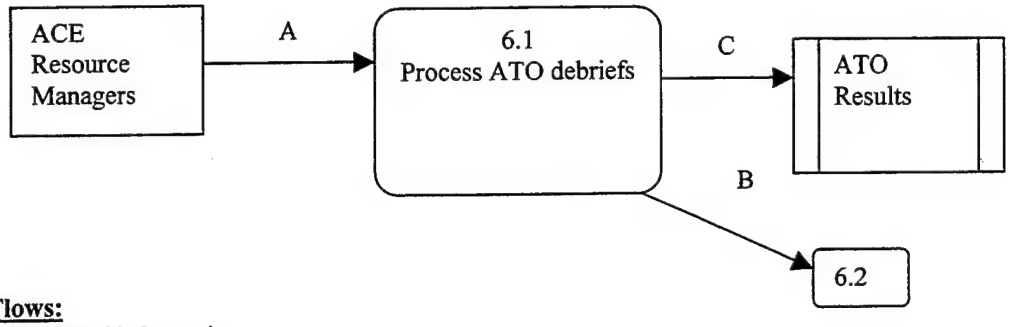
10. Which C4I systems support this process?

CTAPS maintains the ATO. The Tactical Combat Operation provides the common operational picture which gives the Current Operations Directorate an "eye in the sky" view of the ATO as it is being executed.

Process 6.0 Data Flows

A – ATO Debrief Information
B – ACE Asset Status Information
C – Resource Expenditure Data
D – Post Mission Target Analysis
E – Processed ATO Debrief Information
F – Post Mission Target Assessment
G – Squadron Sortie Rates
H – Updated Force Laydown
I – Updated Aircraft Availability
J – Updated Aircrew Availability
K – Processed Resource Expenditure Information

Process – 6.1



Data Flows:
A – ATO debrief information
B – ATO post-mission target analysis
C – Processed ATO debrief information

Process 6.1 Description: This process collects and processes the post-mission reports from all of the units participating in the ATO. Information relating to target analysis or target status or forwarded to process 6.2, all other processed post-mission information is forward to the ATO results data store.

1. **What entities does this process affect?**
   ACE Resource Managers
   ATO results

2. **How many users does this process have?**
   This process is accessed by the Future Plans, Future Operations, and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is the primary owner of this process since they will use the information when they develop the next ATO.

4. **How often is this process used?**
   This process is executed on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever the ACE resource managers update the information to the process.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be medium.

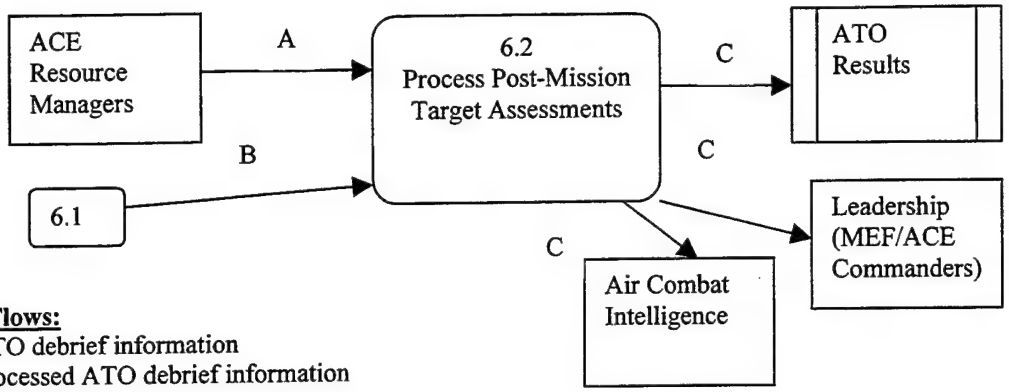
8. **What is the source of information for this process?**
   The ACE resource managers are responsible for providing timely feedback on the ATO missions that have been completed. This information is in the form of post-mission reports, verbal debriefs, and analysis of recordings and images taken during missions.

9. **What is the current status of the process?**

This is fairly complex process with a lot of variations on how it can be completed. The ACE Intranet provides a little support for this process by posting the applicable forms that must be filled out. However these forms are static in nature and only show the format and sequence for the forms.

10. **Which C4I systems support this process?**
Updates to targets are entered into databases in CTAPS and the IAS. Updates to friendly units are entered into the databases in TCO and CTAPS.

Process – 6.2



Data Flows:
A – ATO debrief information
B – Processed ATO debrief information
C - Post-mission target assessments

Process 6.2 Description: This process collects and processes the post-mission target assessment reports from all of the units participating in the ATO and the processed ATO mission debriefs from process 6.1. The process correlates the target assessments with the information from process 6.1 and forwards that information back to the Intelligence directorate and the leadership. This information is also stored in the ATO results data store.

1. **What entities does this process affect?**
   ACE Resource Managers
   ATO results

2. **How many users does this process have?**
   This process is accessed by the Future Operations and Current Operations Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is the primary owner of this process since they will use the information when they develop the next ATO.

4. **How often is this process used?**
   This process is executed on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever the process receives post-mission target assessment information following completion of an ATO.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ.** This process uses multiple updates and multiple queries.

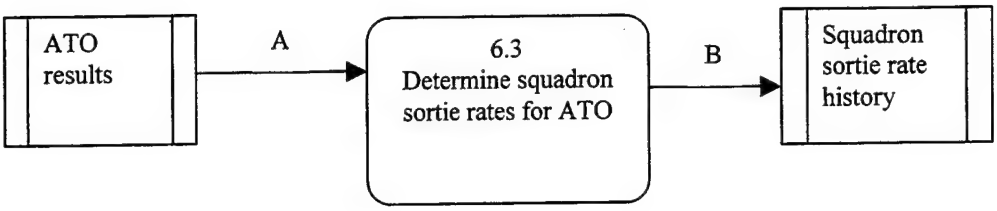
7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be medium to high.

8. **What is the source of information for this process?**
   The ACE resource managers are responsible for providing timely target assessment feedback based on the ATO missions that have been completed. This information is in the form of post-mission reports, verbal debriefs, and analysis of recordings and images taken during missions.

9. **What is the current status of the process?**
This is fairly complex process with a lot of variations on how it can be completed. The ACE Intranet provides a little support for this process by posting the applicable forms that must be filled out. However these forms are static in nature and only show the format and routing sequence for the forms.

10. **Which C4I systems support this process?**
Updates to targets are entered into databases in CTAPS and the IAS. Updates to friendly units are entered into the databases in TCO and CTAPS.

Process – 6.3



Data Flows:
A – ATO debrief information
B – Squadron sortie rates

Process 6.3 Description: This process parses the ATO results data store to determine the number of sorties each individual squadron flew during the ATO. This information is stored in the Squadron sortie rate history data store and will be used by process 2.4.

1. **What entities does this process affect?**
   ACE Resource Managers
   ATO results
   Squadrons
   Sorties
   Sortie Rates

2. **How many users does this process have?**
   This process is accessed by all three of the ACE Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is the primary owner of this process since they will use the information when they develop the next ATO.

4. **How often is this process used?**
   This process is executed on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever the process receives new sortie information in the ATO results data store.

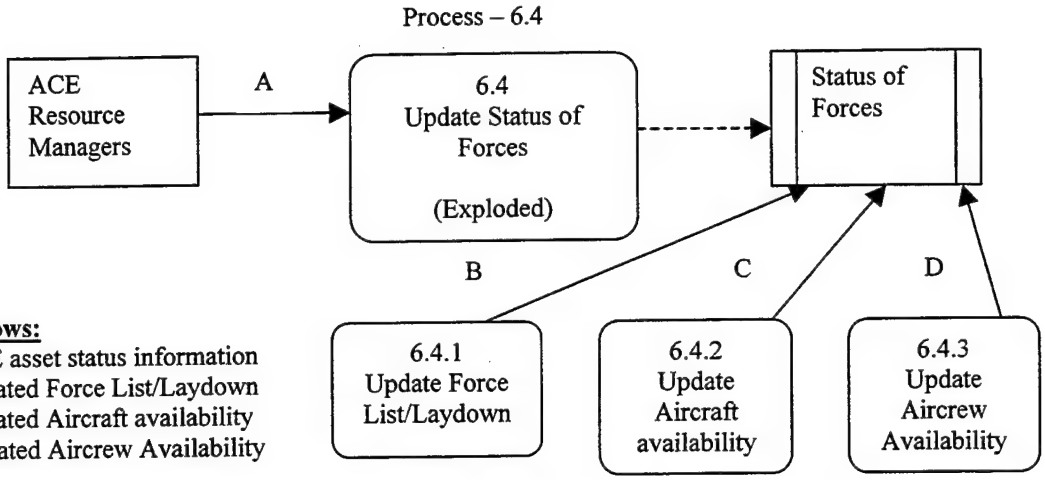
6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is unclassified but sensitive and customized and the volume of information will be low.

8. **What is the source of information for this process?**
   The ACE resource managers (squadrons in this case) are responsible for providing their sortie information. This information is in the form of standard reports, email, and messages that are generated following each mission

9. **What is the current status of the process?**
This process is not currently on the ACE Intranet. The information is partly automated through the use of email and standard reports and message traffic that the ACE resource managers forward up the chain of command after completion of each mission.

10. **Which C4I systems support this process?**
CTAPS provides the information on how many sorties each squadron was scheduled to fly and can also be used to track the actual number of sorties the squadron produced if it is used properly.



Data Flows:
A – ACE asset status information
B – Updated Force List/Laydown
C – Updated Aircraft availability
D – Updated Aircrew Availability

Process 6.4 Description: This process updates the status of forces information based on inputs from the ACE resource managers. This process can be exploded down into three processes that update the force list/laydown for the ACE, and update the aircraft and aircrew availability by squadron. All of the processed information is forwarded to the status of forces data store.

1. **What entities does this process affect?**
   ACE Resource Managers
   Aircraft
   Aircrew
   Squadrons
   Force List/Laydown
   Status of Forces

2. **How many users does this process have?** This process is accessed by all three of the ACE Directorates.

3. **Who is the primary owner of this process?**
   The Future Operations Directorate is the primary owner of this process since they will use the information when they develop the next ATO.

4. **How often is this process used?** This process is executed on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever the process receives new status of forces information from the ACE resource managers which should happen at least daily.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ.** This process uses multiple updates and multiple queries.

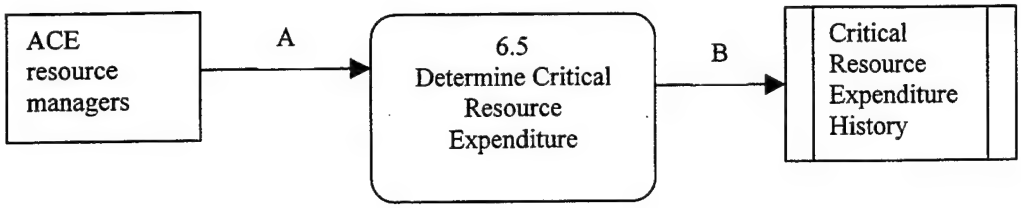
7. **What type of information does this process use?**
   Most of the information is classified and customized and the volume of information will be low.

8. **What is the source of information for this process?**
   The ACE resource managers (squadrons in this case) are responsible for providing their information regarding the status of their assets (aircraft, aircrew). This information is in the form of standard reports, email, and messages that are generated following at the end of the 24 hour ATO cycle.

9. **What is the current status of the process?** This process is not currently on the ACE Intranet. The information is partly automated through the use of email and standard reports and message traffic that the ACE resource managers forward up the chain of command after completion at a specified time.

10. **Which C4I systems support this process?**
CTAPS provides the some information on the force list and force laydown. CTAPS also provides some the capability to keep track of aircraft and aircrew if the squadron's can get the information entered into CTAPS.

Process – 6.5



Data Flows:
A – Resource expenditure data
B – Processed resource expenditure information

Process 6.5 Description: This process receives and processes the information on the amount of critical resources expended during the ATO cycle for each base. This information is stored in a data store that will be used by process 2.6 to determine the critical resource utilization rate.

1. **What entities does this process affect?**
   ACE Resource Managers
   ATO results
   Critical Resources
   Critical Resource Expenditure History
   Base

2. **How many users does this process have?**
   This process is accessed by all three of the ACE Directorates.

3. **Who is the primary owner of this process?**
   The Future Plans Directorate is the primary owner of this process since they will use the information when they develop the ACE's next aviation plan.

4. **How often is this process used?**
   This process is executed on a daily basis.

5. **How often is this process updated?**
   This process should automatically update whenever the ACE resource managers enter new critical resource expenditure information.

6. **What is the mode of use for this process by the entities that use it? SU/SQ,SU/MQ, MU/SQ, MU/MQ**
   This process uses multiple updates and multiple queries.

7. **What type of information does this process use?**
   Most of the information is unclassified but sensitive and customized and the volume of information will be medium.

8. **What is the source of information for this process?**
   The ACE resource managers are responsible for providing information regarding the usage of their critical resources (fuel, ordnance, spare parts). This information is in the form of standard reports, email, and messages that are generated by the resource managers at a specified time

9. **What is the current status of the process?**
This process is not currently on the ACE Intranet. The information is partly automated through the use of email and standard reports and message traffic that the ACE resource managers forward up the chain of command when required.

10. **Which C4I systems support this process?**
CTAPS provides limited support for processing and storing critical resource expenditure information.

APPENDIX B. PROCESS ANALYSIS

ACE ATO system processes likely to benefit from Intranet

Ranking for impact of including the process on the Intranet - 1 (poor) to 10 (excellent).
Ranking for time required to incorporate onto Intranet - 1 (long time) to 10 (short time).

1. Process 1.1 (Analyze future MEF Mission Plans) – not a candidate for Intranet.

2. Process 1.2 (Develop ACE courses of action) – CANDIDATE
   a. This process is very suitable for incorporation onto the ACE Intranet because it would increase the ability of the users to view the courses of action as they were being developed and would also allow each COA to be stored for future review. As each COA is being developed and refined it could be posted on the Intranet for quicker feedback and inputs.
   b. Impact ranking – 7.
   c. Time required ranking – 3.

3. Process 1.3 (Develop ACE estimate of support) – CANDIDATE
   a. This process is a prime candidate for incorporation onto the ACE Intranet because it must access information that is updated frequently (status of forces). The results of this process need to be available to several users as quickly as possible which the Intranet would allow.
   b. Impact ranking – 8.
   c. Time required ranking – 5.

4. Process 1.4 (Brief COA's to ACE Commander) – not a candidate for Intranet.

5. Process 1.5 (Select COA) – not a candidate for Intranet.

6. Process 1.6 (Develop ACE Aviation Plan) – CANDIDATE
   a. Parts of this process could be incorporated onto the ACE Intranet. Specifically, the status of forces information should be available from the Intranet since this information changes frequently and will require multiple queries.
   b. Impact ranking – 8.
   c. Time required ranking – 4.

7. Process 2.1 (Determine Force List/Laydown) – CANDIDATE.
   a. This process is an excellent candidate for the ACE intranet. The information provided by this process is utilized several times a day by numerous users. Posting this information on the Intranet would relieve the requirement to maintain the information on whiteboards or clipboards.

b. Impact ranking – 9.
c. Time required ranking – 8.

8. Process 2.2 (Determine Aircraft Availability by Squadron) – CANDIDATE.
   a. This process is a prime candidate for the ACE Intranet. Instead of having the ACE staff try to keep this information current with phone calls and emails with the squadrons, the squadrons could update the information themselves. This process will see frequent use and will have frequent updates.
   b. Impact ranking – 9.
   c. Time required ranking – 4.

9. Process 2.3 (Determine Aircrew Availability by Squadron) – CANDIDATE.
   a. This process is a prime candidate for the ACE Intranet. Each squadron could assume responsibility of maintaining the information and making it readily available to the ACE staff. This process will have frequent updates and will have frequent use.
   b. Impact ranking – 9.
   c. Time required ranking – 4.

10. Process 2.4 (Compute Squadron's Projected Sortie Availability) – CANDIDATE.
    a. This process is an excellent candidate for the ACE Intranet. For every update to the availability of aircraft and aircrew, this process will automatically compute the number of sorties a squadron can generate. This process would replace the paper and pencil method currently used by the Future Plans Directorate.
    b. Impact ranking – 9.
    c. Time required ranking – 2.

11. Process 2.5 (Determine amount of each type of critical resource available at each airfield) – CANDIDATE.
    a. Excellent candidate. This information is vital to the ACE battle staff and will be accessed frequently and updated frequently. Putting this process on the Intranet will allow the Future Plans and Future Operations Directorates to monitor availability of critical resources at each airfield. The airfield would be responsible for maintaining and updating the information.
    b. Impact ranking – 9.
    c. Time required ranking – 2.

12. Process 2.6 (Compute the projected expenditure rate of each critical resource at each airfield) – CANDIDATE.
    a. Excellent candidate. This information is also vital to the ACE battle staff and will be accessed and updated frequently. Both the Future Plans and the Future Operations Directorates will be able to use this information to monitor how quickly the critical resources are being expended at each airfield.
    b. Impact ranking - 9.

c. Time required ranking - 2.

13. Process 3.1 (Analyze Commanders' Guidance and Objectives) - CANDIDATE.
    a. The Rules of Engagement, the Air Apportionment Decision, and the Commanders' guidance and objectives all need to be made available throughout the ACE in a timely manner and must be continually updated to reflect the latest direction. The results of this process could be posted on the Intranet and would ensure fast and thorough dissemination.
    b. Impact ranking - 7.
    c. Time required ranking - 5.

14. Process 3.2 (Analyze Aviation Plan) - not a candidate for Intranet.

15. Process 3.3 (Analyze ATO results) - not a candidate for Intranet.

16. Process 3.4.1.1 (Develop aircraft flow plan rough) - not a candidate for Intranet.

17. Process 3.4.1.2 (Identify ACE assigned targets) - CANDIDATE.
    a. This process would be a good candidate for the ACE Intranet. The actual identification or selection would not go on the Intranet, but the results of the process could be posted. This information would be frequently accessed by numerous users and updated frequently. The ACE assigned targets list is changed frequently so all users would be able to view only the latest information.
    b. Impact ranking - 7.
    c. Time required ranking - 4.

18. Process 3.4.1.3 (Conduct weaponeering and force application) - not a candidate for Intranet.

19. Process 3.4.1.4 (Develop ACE MAAP) - not a candidate for Intranet.

20. Process 4.0 (Disseminate ATO) - CANDIDATE.
    a. The ATO dissemination process is fully automated with CTAPS, but the Frag Order dissemination process would be a good candidate for incorporation onto the Intranet. The Frag Order needs to be quickly distributed to all of the lower commands to let them know what will be expected of them during the future ATO cycle. Posting this information on the Intranet would remove requirement for producing paper copies of the Frag order and would that each subordinate always had access to the latest information.
    b. Impact ranking - 5.
    c. Time required ranking - 3.

21. Process 5.1 (Monitor status of ACE assets) - CANDIDATE.

a. The Current Operations Directorate must have continuous access to the most current information on the status of the ACE assets. This process is an excellent candidate for the Intranet because it would replace or supplement the greaseboard method that is now used to support this process. The status of ACE assets changes frequently and will be accessed frequently.
b. Impact ranking - 9.
c. Time required ranking - 2.

22. Process 5.2 (Implement Leadership decisions) - not a candidate for the Intranet.

23. Process 5.3 (Monitor ACE assigned target status for current ATO) - CANDIDATE.
    a. The Current Operations Directorate is responsible for adjusting ATO missions if a change of status in an ACE target requires it. This information also needs to be available to all of the units that will be executing the ATO so they will have the latest information on their assigned targets. This process is an excellent candidate for the ACE Intranet.
    b. Impact ranking - 9.
    c. Time required ranking - 4.

24. Process 5.4 (Adjust ACE assigned targets on current ATO) - not a candidate for the Intranet.

25. Process 5.5 (Adjust ATO missions) - not a candidate for the Intranet.

26. Process 5.6 (Execute ATO) - not a candidate for the Intranet.

27. Process 6.1 (Process ATO debriefs) - CANDIDATE.
    a. Each unit or directorate should be able to enter post-mission debriefing information directly into an on-line database. This would greatly alleviate the requirement to complete post-mission forms and reports that are currently generated for this process.
    b. Impact ranking - 6.
    c. Time required ranking - 5.

28. Process 6.2 (Process Post-Mission Target Assessments) - CANDIDATE.
    a. Part of this process could be incorporated onto the Intranet. As the aircrew debriefs their results against their assigned targets the information could be posted directly to an online database. This information would then be readily accessible for the Air Combat Intelligence personnel as they update the target status.
    b. Impact ranking - 5.
    c. Time required ranking - 2.

29. Process 6.3 (Determine Squadron sortie rates for ATO) - CANDIDATE.

a. As the squadron aircraft return from their sorties, the sortie information could be fed into an online database that will determine the actual number of sorties the squadron generated. The information in the database will be used frequently by other processes. This process would also allow the Current Operations Directorate and the ACE Commander to know how well each squadron is holding up.
b. Impact ranking - 7.
c. Time required ranking - 7.

30. Process 6.4.1 (Update Force List/Laydown) - CANDIDATE.
    a. Each of the units in the ACE would be responsible for updating an online database that directly supports several other processes. The information from this process will be updated frequently and will be frequently accessed by the ACE Commander and the Directorates.
    b. Impact ranking - 7.
    c. Time required ranking - 2.

31. Process 6.4.2 (Update Aircraft availability) - CANDIDATE.
    a. Same as 6.4.1.
    b. Impact ranking - 7.
    c. Time required ranking - 2.

32. Process 6.4.3 (Update Aircrew availability) - CANDIDATE.
    a. Same as 6.4.1.
    b. Impact ranking - 7.
    c. Time required ranking - 2.

33. Process 6.5 (Determine critical resource expenditure) - CANDIDATE.
    a. Each airfield would be responsible for updating an online database with the appropriate information. This information is critical to the ACE directorates and must be accurate and quickly updated. Posting the information from this process on the Intranet will ensure quick dissemination to those who need the information.
    b. Impact ranking - 8.
    c. Time required ranking - 6.

APPENDIX C. MIGRATION CANDIDATES

Choice of Processes for ATO Decision Support

It is assumed that all of these processes will run on a secure, TCP/IP-based, wide area network (WAN) that connects all units of the ACE (ACE Intranet). Currently such a WAN does not exist other than the Secret Internet Protocol Routed Network (SIPRNET) that serves as the ACE Intranet.

All of the processes described below will involve accessing a database (Microsoft Access) on a NT server class machine with Internet Information server running as the web server and Cold Fusion 3.0 running as the engine for the dynamic database queries.

The content provider will have to be very familiar with SQL, Cold Fusion, Access, and HTML source code.

1. **Process 2.1 (Determine Force List/Laydown)**
   a. This process will display the most current information regarding the location and status of the forces assigned to the ACE. This information will be presented as a dynamic web page that can be updated as frequently as needed. The ACE battlestaff will be the primary users of this page. They will need to have a computer on the secure ACE WAN with a browser.
   b. The content provider will require an HTML editor that is fully compatible with Cold Fusion tags (Hot Dog or a text editor).
   c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be password protected so that only authorized users can update the information. The web page will be available to anybody with access to the ACE WAN.
   d. The individual units will be responsible for the upkeep of their information and will be given passwords to allow them access to their database information.
   e. Users will be able to view the entire list as well as drill down to view more specific information about a unit of interest.
   f. **Critical success factors for this process on the Intranet**. The information for this process should become readily available for any interested user at any time. Updates to this process should be posted for all users to see as soon as changes are made. Any changes to the Force List/Laydown should immediately be updated and available for viewing. The information presented on the web page must be easily understood for all potential users.
   g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability within the ACE regarding the force

list/laydown. Individual units will no longer be required to provide daily status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources to maintain this information since it will be done almost automatically.

2. **Process 2.2 (Determine aircraft availability).**
   a. This process will provide the process users with the projected aircraft availability for each squadron. This information will be presented as a dynamic web page for each squadron. Information on each of the squadron's aircraft will be available by drilling down to see the individual aircraft's status. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.
   b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.
   c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be password protected so that only authorized users can update the information. The web page will be available to anybody with access to the ACE WAN.
   d. The individual squadrons will be responsible for entering the information on their aircraft status as it changes. Each squadron will designate a representative to manage their information on the webpage. This representative will be given a password that allows him to update only the squadron's information.
   e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.
   f. **Critical Success Factors for this process on the Intranet**. This process must present accurate, reliable information in a timely manner when the status of a squadron's aircraft changes. The information presented to the user must be clear, concise, and easily understood. The user should have the option of drilling down into the data to get amount of information required.
   g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability required to monitor and update the status of squadron aircraft. Individual units will no longer be required to provide daily status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to maintain this information since it will be done by the units and individuals with the best information.

3. **Process 2.3 (Determine aircrew availability).**
   a. This process will provide the process users with the projected aircrew availability for each squadron. This information will be presented as a dynamic web page for each squadron. Information on each of the squadron's aircrew will be available by drilling down to see the individual aircrew's status. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.

b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.
c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be password protected so that only authorized users can update the information. The web page will be available to anybody with access to the ACE WAN.
d. The individual squadrons will be responsible for entering the information on their aircrew status as it changes. Each squadron will designate a representative to manage their information on the webpage. This representative will be given a password that allows him to update only the squadron's information.
e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.
f. **Critical Success Factors for this process on the Intranet**. This process must present accurate, reliable information in a timely manner when the status of a squadron's aircrew changes. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the amount of information he requires about the selected aircrew.
g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability required to monitor and update the status of squadron aircrew. Individual units will no longer be required to provide daily status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to maintain this information since it will be done by the units and individuals with the best information.

4. **Process 2.4 (Compute Squadron's projected sortie availability).**
   a. This process will compute the projected number of sorties a squadron could generate given the aircraft and aircrew availability of that squadron. The sortie rates will be computed for both sustained operations and surge operations. This information will be presented as a dynamic web page for each squadron. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.
   b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.
   c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be available to anybody with access to the ACE WAN.
   d. This process will utilize the information from processes 2.2 and 2.3. The only input required from the user is to possibly adjust the variables for sustained and

surge flight operations. The Future Operations Directorate will designate a representative to manage the sortie calculation functions associated with this process. This representative will be given a password that allows him to update sortie calculation variables.

e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.

f. **Critical Success Factors for this process on the Intranet.** This process must present accurate, reliable information in a timely manner that is recomputed whenever the status of a squadron's aircrew or aircraft changes. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the amount of information he requires about the number of sorties a squadron should be able to generate.

g. **Interoperability issues for this process.** This process should greatly improve the flow of information and interoperability required to monitor and update projected number of sorties a squadron should be able to generate. Individual units will no longer be required to provide daily status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to calculate this information since it will be done automatically based on the inputs from the units and individuals with the best information.

5. **Process 2.5 (Determine amount of each type of critical resource available at each airfield).**
   a. This process will track the amount of each type of critical resource (ordnance, fuel, spare parts) available at each airfield. This information will be presented in the form of a dynamic web page for each airfield. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.
   b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.
   c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be password protected so that only authorized users can update the information. The web page will be available to anybody with access to the ACE WAN.
   d. Each airfield will designate a representative responsible for monitoring and maintaining the amount of each critical resource that the airfield has on hand. This representative will be given a password that allows him to update the information on the critical resource as it changes. The information will be updated on web-based input form that updates the central database.
   e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.

f. **Critical Success Factors for this process on the Intranet**. This process must present accurate, reliable information in a timely manner that is adjusted whenever the status of an airfield's critical resource needs to be updated. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the amount of information he requires about the amount of each type of the critical resource that the airfield has on hand.

g. **Interoperability issues for this process.** This process should greatly improve the flow of information and interoperability required to monitor and update the status of the critical resources on all of the airfields operated by the ACE. Individual units will no longer be required to provide status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to calculate this information since it will be done automatically based on the inputs from the airfields and individuals with the best information.

6. **Process 2.6 (Compute the projected expenditure rate of each critical resource at each airfield).**
   a. This process will compute the expenditure rate of each type of critical resource (ordnance, fuel, spare parts) at each airfield. This information will be presented in the form of a dynamic web page for each airfield. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.
   b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.
   c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be available to anybody with access to the ACE WAN.
   d. This process will utilize the information generated in process 2.5 and the stored in the database to compute the expenditure rate. This process should update itself automatically as process 2.5 is updated.
   e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.
   f. **Critical Success Factors for this process on the Intranet**. This process must present accurate, reliable information in a timely manner that is adjusted whenever the status of an airfield's critical resource needs to be updated. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the amount of information he requires about the project expenditure rate for each type of critical resource at every airfield.
   g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability required to monitor the expenditure rate of critical resources on all of the airfields. Individual units will no longer be

required to provide status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to calculate this information since it will be done automatically based on the data in the database and the results of process 2.5.

7. **Process 5.1 (Monitor status of ACE assets).**
   a. This process will display the most information and status for the ACE assets (aircraft, aircrew, resources). This information will be presented in the form of a dynamic web page. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.
   b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.
   c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be available to anybody with access to the ACE WAN.
   d. This process will utilize the information generated in process 2.0 and stored in the database to display the status of the ACE assets. This process should update itself automatically as process 2.0 is updated.
   e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.
   f. **Critical Success Factors for this process on the Intranet**. This process must present accurate, reliable information in a timely manner that is adjusted whenever the status of any of the ACE assets is changes. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the amount of information required.
   g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability required to monitor the status of the ACE assets. Individual units will no longer be required to provide status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to calculate this information since it will be done automatically based on the data in the database and the results of process 2.0.

8. **Process 6.3 (Determine squadron sortie rates for ATO).**
   a. This process will calculate the most number of sorties each squadron was actually able to generate in support of the ATO. This information will be presented in the form of a dynamic web page. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.
   b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.

c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be available to anybody with access to the ACE WAN.
d. This process will utilize the information input by the squadrons and stored in the database to display the number of sorties the squadron generated. This process should update itself automatically as the new inputs are made. Each squadron will assign a responsible person to input the information for that squadron. The input page will be password protected so that only the authorized person may enter or adjust the data.
e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.
f. **Critical Success Factors for this process on the Intranet**. This process will provide the Future Operations, Current Operations Directorates and the ACE Commander with the best information on how well the squadrons are meeting their tasking. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the level of detail required.

g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability required to monitor the performance of the squadrons. Individual units will no longer be required to provide status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to calculate this information since it will be done automatically based on the inputs provided by the squadrons.

9. **Processes 6.4.1, 6.4.2, 6.4.3 (Update force laydown, aircraft availability, and aircrew availability).**
   a. This process will update the information for these fields by incorporating the post-mission debriefs. This information will be presented in the form of a dynamic web page. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.
   b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags.
   c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be available to anybody with access to the ACE WAN.
   d. This process will utilize the information input by the squadrons and stored in the database to update and display the most current status on force laydown, aircraft availability, and aircrew availability by squadron. This process should update

itself automatically as the new inputs are made. Each squadron will assign a responsible person to input the information for that squadron. The input page will be password protected so that only the authorized person may enter or adjust the data.

e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.

f. **Critical Success Factors for this process on the Intranet**. This process will provide the Future Operations, Current Operations Directorates and the ACE Commander with the best information on the status of the ACE's forces and specifically on the aircraft and aircrew of each squadron. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the level of detail required.

g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability required to monitor the status of the ACE's forces. Individual units will no longer be required to provide status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to calculate this information since it will be done automatically based on the inputs provided by the squadrons.

10. Process 6.5 (Determine critical resource expenditure).

a. This process will determine how quickly the critical resources on each airfield are being expended. This information will be presented in the form of a dynamic web page. The process users (ACE battlestaff) will require access to the ACE's secure WAN with a web browser.

b. The content provider will require an HTML editor that is fully compatible with the Cold Fusion tags to generate the web page. The content provider will enter the information into a web-base form that updates the central database.

c. Security issues – the ACE WAN is isolated from outside penetration. The files on the web server that support this process will be protected by Windows NT server Access Control Lists (ACLs) to ensure that only authorized content providers can alter the page. The web page will be available to anybody with access to the ACE WAN.

d. This process will compute the information input by the various owners of the critical resources of each airfield and display it on a web page. This process should update itself automatically as the new inputs are made. Each critical resource at each airfield will assign a responsible person to manage the information. The input page will be password protected so that only the authorized person may enter or adjust the data.

e. Anybody with access to the ACE WAN will be able to view the information but will not be allowed to change it.

f. **Critical Success Factors for this process on the Intranet**. This process will provide the Future Plans, Future Operations, Current Operations Directorates and

the ACE Commander with the best information on how quickly critical resources are being expended at each airfield. The information presented to the user must be clear, concise, and easily understood. Each user should have the option of drilling down into the data to get the level of detail required.

g. **Interoperability issues for this process**. This process should greatly improve the flow of information and interoperability required to monitor the status of the ACE's forces. Individual units will no longer be required to provide status reports to the ACE headquarters. The ACE headquarters staff will no longer have to dedicate the manpower and resources currently required to calculate this information since it will be done automatically based on the inputs provided by the critical resource managers at each airfield.

APPENDIX D. USER COMMENTS

Years Experience of User 21

MOS: 6802/6877 WEATHER SERVICE OFFICER/WTI

The new Meteorology Mobile Facility (METMF(R))is being fielded this year. It will have the capability to host web pages and automatically push data. Your program should be made to intigrate with this system for injest of weather data as outlined in paragraph 6. POC on the specifics of the METMF(R) is Maj Resavy at DSN 332-2331. My phone number is DSN 951-2534, E-Mail dixonj@yuma.usmc.mil

Need to be able to have atomated injest of current and forecast weather at each airfield and at the target site. EOTDAs could also be automatically generated and this information could be tied to the type of weapon sytem selected.

I think it could become a very usefull tool.

Years Experience of User 21

MOS: 6802/6877 WEATHER SERVICE OFFICER/WTI

Need to have the capability to auto injest weather data from the METMF(R). This data should be injested for the airfields and the target area. EOTDAs should be automatically generated based on the target, the weapon system used and the weather over the target area.

Years Experience of User 8

MOS: 7588

Any thought given to making this interactive to TAMPS or the follow on CMSS (Common Mission Support System)? I am assuming that the system would be a tool for the S-3/ODO to keep apprised of the daily ACE ops. COPS/FOPS guys at the ACE could definitely use the up to date info. However it is only as current as the individual units make it. SQN S-3 would find a "point and click" schedule much easier to write. More to follow.

Hi Spike: VR TREE

Especially helpful in a scenario where the ace is supporting multiple sites, or squadron reps are located away from the S-3. (Vincenza and the CAOC)

Mission commander would be able to get rapid info from the website as to who they are supporting. ATO info is amplified and follow on mission planning would be expedited.

Years Experience of User 6

MOS: 7210/7277

This is interesting. Thanks

dlpowers@nps.navy.mil

I'm very impressed with the obviously high level of effort that went into this product. Outstanding tool. Having participated in all phases of the ATO cycle I feel that a tool such as this would be very helpful. Having ready access to this type of information would greatly enhance the TAOC's, ATC's and DASC's ability to anticipate equipment and crew requirements.

Understanding that the scope of your project did not include the ACE C2 squadrons I feel that a flying squadron's execution of the ATO could be enhanced by the addition of some more C2 info (freqs, control agency c/s and status etc). My reasoning for this is that it would be nice not to have go to another source to collect/look for these other bits of info. Inclusion of a TAOC/DASC/ATC input section would be a possible way to provide this data.

Years Experience of User 6

MOS: 7588

It appears that this system requires a great deal of maintenance. Although I don't know much about data bases yet, I believe making it a relational database would minimize the updating requirements by the ODO and squadron S-3. When he updates his ODO board schedule depicting an aircraft as airborne or on deck, that info should automatically be entered on the current ATO and all other appropriate places. I don't know if that is the way you have it set up.

It would; however, you need backing from some powerful players to make this a requirement. Unless it becomes a required task, people will not update it.

It has great potential, not only for the ACE staff but also for regular aircrew. It sure would be nice to access all the information necessary in this format.

Years Experience of User 22

MOS: 7202

Great work. GUI is outstanding.

User friendly. This, in itself corrects one of the more common complaints regarding the use of CTAPS by Marines. As the Service standard for ATO production and dissemination, CTAPS is the model this tool should be built towards. It is only valuable if it can be used in the Joint environment. Unless its planned usage is only at the Squadron/Group level. But then it becomes a unique, stovepipe system and non-compliant with the Service standard

Very useful for this purpose. See comments from question 6, for overall usefulness.

Years Experience of User 6

MOS: 7202

PLEASE CONTACT ME AT DSN 636-3114 (MAJ P.F. COX) OR coxp@okinawa.usmc.mil. I WILL REPRESENT MARCORSYSCOM FOR TBMCS AND JTIDS AT THE ELECTRONIC SUPPORT CENTER.

THE SOFTWARE IS INNOVATIVE, USER-FRIENDLY AND REFLECTS A GRAT DEAL OF THOUGHT. IF IT COULD SOMEHOW BE MADE TO INTERACT WITH TBMCS, MANY OF ITS FUNCTIONS WOULD HELP ACE PLANNERS.

IT SEEMS THE SOFTWARE IS MAPPED TO AN ATRIMS DATA BASE, WHICH IS A NOVEL IDEA. SOME SPECIFIC INFO FIELDS (AIRFIELDS, ETC) ARE PRESENTED IN MORE USER FRIENDLY WAYS THAN ARE FOUND IN CTAPS/TBMCS.

Years Experience of User 6

MOS: 7210

Very good at planning at squadron level but is redundant to CTAPS. To copy all ATO information created in CTAPS (Joint Standard) would be very time consuming.

Interface with ATRIMS is very usefull. But again the squadrons would have to execute the ATO in CTAPS as well.

Years Experience of User 5

MOS: 7204

this appears to be along the same lines as tbmcs... which may eventually go to a pc/web based application. ctaps and then tbmcs are the joint standard. anything less is useless for the magtf as the aviation community is a joint community, 99% of the time.

it seems to do the same as ctaps

Years Experience of User 12

MOS: 7588

no

This will be extremely useful if it is kept current. To keep this current it would have to be a tool that each squadron used not just another tasker from higher headquarters that had to be updated. For example this would have to be the snivel log, flight schedule, aircraft availability report from maintenance, etc, etc. It has to provide utility to the squadron not just to higher headquarters.

From what I've seen it is tailored to the ACE staff. Believe that if it was used in peace time as well as conflict and facilitated the day to day squadron tasks such as juggling the snivels, writing the flight schedule, tracking aircraft scheduled and unscheduled maintenance it would be ideal...but perhaps out of the scope of your thesis.
sf
quickdraw

Years Experience of User 8.5

MOS: 7588, 7577 (MAWTS-1 INSTRUCTOR)

Yes, will e-mail you Spike.

S/F
Serg

Certainly the prototype has the major functionalities of ATO generation. I see a lot of application here at MAWTS-1 during WTI. MAWTS-1 is currently developing a plan to generate electronic flight schedules that would interact with CTAPS in ATO generation. This prototype may be very useful in that regard. Will e-mail you with details.

Useful info passed to squadron level. For example intel updates, airfield and ordnance status and lessons learned.

If I were using this prototype at the squadron level, I would like to see a little more development in the ATO to flight schedule transition. Already there are some useful tools included. i.e. aircrew quals and availability.

Some of the areas that can be further developed for sqadron use are: scheduling and deconfliction of ranges, tanker times, etc. Management of standard conventional loads (SCLs) for aircraft with up to 10 stations and up to 100 various SCL combinations. An ability to include detailed flight schedule notes associated with each sortie. More detailed aircrew time management. i.e. down to 15 min intervals and within crewday constraints. Also ability to genreate aircrew flowsheets for each day showing aircrew scheduling and compliance with crew day constraints. Links between aircrew quals and type of aircraft flown (e.g. FA-18A vs FA-18C) and links between quals and sorties flown (e.g. DEFTACI required to fly first-time BAM). Ability to map out T&R flow (e.g. need high tacform before section low-level).

Understand your focus is the ATO execution, however, the prototype is well on its way to being a flt sked tool. It would make sense to use the data already available in prototype for daily flt sked generation. This would go a long way towards making ATO to flt sked flow seamless.

Years Experience of User

MOS: 7202 (7208)

Years Experience of User 11

MOS: 7202 (7208)

Allow the user to adjust the viewable fields of the ATO displays.
Ensure that the tool is interoperable with existing and planned ATO msgs.

Ensure that the fields in the ATO data base match those of the actual ATO conf msg.

Years Experience of User 8

MOS: 7588

As you recognize, your prototype already accomplishes much of this. Some of the other functions you provide (like airfield status, ordnance supply status, ATO execution updates, lessons learned, intel updates, ...) would also be of use during WTI. However, the current focus is on getting the flight schedule monster under automated.

If we can make this work at MAWTS-1--with all the communities operating simultaneously--then we would likely have a product that can be used by any ACE from wing-size to individual squadrons.

I have a few questions (unofficial inquiry):

*Is it possible for MAWTS-1 to be a test bed for your prototype as it applies to the functions listed above?
*If so, do you think we could learn to tailor it to the specific requirements we have identified?
*What flavor is the underlying database? (MS Access, ...)
*Besides your ACE ATO prototype, are there any other projects out at NPS that come close to fulfilling these requirements?
*What future plans does MCTSSA have for your prototype?

Like you asked, I passed around the address to your thesis project's web site. Hopefully you got some visits from MAWTS-1 folks. I logged on a few times and yesterday I sent off a questionnaire from your site outlining the flt sked project we're working on at MAWTS-1. Several of us were discussing the requirements for this project yesterday and thought that your prototype might have some application here. I demo'd your site to a few folks and outlined the consensus on the questionnaire

Here's the background:
We just upgraded the MAWTS-1 computers. Currently every instructor has a 233 Dell on his desk that will be connected by an Intranet in the next few weeks. We're trying to establish an electronic flight schedule system for WTI that will take advantage of this upgrade. The flight sked sys would have to be capable of working with every community in TACAIR and Assault Support. Here are some of the functions it will serve:

-Range scheduling and deconfliction (including graphical depiction of range complex)
-Aircrew scheduling (to 15 min increments, within crew day constraints and with a snivel system)
-Ordnance management using standard conventional loads (SCLs) for platforms with up to 10 stations and up to 100 SCLs
-Matching of aircrew quals to platform (e.g. various FA-18 flavors A vs C vs D, etc)
-Matching aircrew quals with certain sorties (e.g. section leader required, LATI required, etc)
-Management of Flt Sked notes (including automatic note numbering and simple updating)
-Flight hour and sortie tracking for Ops reporting and applying 3710 limitations
-Syllabus flow using sortie/T&R codes (i.e. sortie x must be completed before sortie y, etc)

-Reports: Daily Flt Sked, Daily Range Utilization Flows, Daily Crewday Flow per aircrew, Flt Hr flow, Sortie Flow
-Interface with CTAPS for ATO generation

Years Experience of User 10

MOS: 7588

First, does the system at all track ordnance, such that the inventory is reduced based on what is loaded on an aircraft? Second, I seem to recall that the ordnance data base was devoid of pods, transmitters and the like. That is a beef I have with Blue Flag as well. They track the ordnance of all aircraft, but not pods. Yet, that is our ordnance. As you know, the ECM is limited in number and scope, and critical to mission accomplishment. It seems to me that we need to educate staffs on such criticalities. It is easy for them to see that they can't send out a strike that calls for 50 mark 82s when there are only 20 mark 82s left in the inventory. It's not so easy for them to see that an EA-6B squadron can't send out a second bird that needs a band X pod when all the band X pods are airborne or down, but when there are 15 band Y and Zs. In other words, what do you mean you can't do that, look at all of those pods?

Of course, I'm not suggesting that we leave the pod loads up to them. But neither do we leave the JMEMing to them. Often the ATO says best load for the strikers, however, once that best load is determined by the squadron, the ordnance is tracked. I suppose in our case, it's more of an internal tracking; still, I think that the staff pogues need to have some idea of our limitations and availability. The near-real time flexibility offered by the intenet, and your system, would seem to allow both our internal tracking, while keeping others (vertically and laterally) informed.

Years Experience of User 12

MOS: 7562

looks like a super plan; getting the USMC out of the dark ages will be your hurdle

---

LIST OF REFERENCES

1. Kirk, T., LtCol, Air Defense Systems Division, Marine Corps Tactical Systems Support Activity, Camp Pendleton, CA, memorandum, 5 June 1996.

2. Hoffer, Jeffery A., Joey F. George, Joseph S. Valacich, Modern Systems Analysis and Design, The Benjamin/Cummings Publishing Company, Inc., Menlo Park, CA, 1996.

3. Jansen, Erik, class notes from MN-3105 "Organization and Management," Naval Postgraduate School, Monterey, CA, January 1998.

4. Sridhar, Suresh, research paper, Decision Support Using the Intranet, Naval Postgraduate School, Monterey, CA, February 15, 1997.

5. Whetzel, John K. *Integrating the World Wide Web and Database Technology*, AT&T Technical Journal, March/April 1996.

6. Hammer, Michael and James Champy, Reengineering the Corporation: a manifesto for business revolution. Harpers Business, New York, NY, 1993.

7. Hills, Mellanie, Intranet Business Strategies, Wiley Computer Publishing, New York, NY, 1997.

8. Naval Doctrine Publication 6, *Naval Command and Control*, Department of the Navy, 19 May 1995.

9. C4I Division, Headquarters, U.S. Marine Corps, concept paper, Command and Control, date unknown.

10. Air Land Sea Application Center (ALSA), draft version, JTF Headquarters Information Management (JTF-IM). Air Land Sea Application Center, December 1997.

11. Sridhar, Suresh, Thesis guidance, Intranet: Guidelines for Phase 1 Report, Naval Postgraduate School, Monterey, CA, October 28, 1997.

12. Rakos, John J. Software Project Management For Small to Medium Sized Projects. Prentice-Hall, Englewood Cliffs, NJ, 1990.

13. Burton, Richard, Borge Obel, Strategic Organizational Diagnosis and Design, Kluwer Academic Publishers, Hingham, MA, 1998.

14. USAF, Battlestaff Training School, FY98 Multimedia CD-ROM

15. MEFEX 1-97, Training Syllabus Book 1, Third Marine Aircraft Wing, 21-23 July 1997

16. Foley, Michael J. Major, USMC, *CTAPS 101*, Marine Corps Gazette, May 1998.

17. Gabarro, John J, ed., Managing People and Organizations, Harvard Business School Publications, Boston, Massachusetts, 1992.

18. Marine Corps Combat Development Center, Operational Requirements Document for a Contingency Theater Automated Planning System, 29 December 1994. (CDC homepage, Requirements Division, Approved Documents - http://138.156.112.14/CDCHome.nsf/?OpenDatabase)

19. Marine Corps Combat Development Center, Operational Requirements Document or the Intelligence Analysis System, Change 1, 23 September 1996. (CDC homepage, Requirements Division, Approved Documents - http://138.156.112.14/CDCHome.nsf/?OpenDatabase)

20. Spilman, Ted, CAPT, USN, PMA-233 TAMPS Program Manager Brief, Mission Planning: A Briefing for the Copernicus Requirements Working Group, date unknown.

21. Marine Corps Combat Development Center, Operational Requirements Document for the Tactical Combat Operations System, Change 2, 25 April, 1995. (CDC homepage, Requirements Division, Approved Documents - http://138.156.112.14/CDCHome.nsf/?OpenDatabase)

22. Marine Corps Combat Development Center, Validation Approval for Mission Need Statement for Global Command and Control System, May 1995. (CDC homepage, Requirements Division, Approved Documents - http://138.156.112.14/CDCHome.nsf/?OpenDatabase)

23. AFATDS Overview Brief, Performance and Joint Applications, presented by LTGEN Arnold, 3rd Army, 21Februay, 1996.

24. Marine Aviation Weapons and Tactics Squadron One, Joint Combat Airspace Command and Control Student Handbook, 19 August 1994.

25. Marine Aviation Weapons and Tactics Squadron One, Tactical Air Command Center Student Handbook, 31 January 1995.

26. Marine Aviation Weapons and Tactics Squadron One, Battle Staff Planning and Briefing Student Handbook, 14 December 1994.

27. Marine Aviation Weapons and Tactics Squadron One, Joint Air Operations Student Handbook, 8 August 1994.

28. Marine Aviation Weapons and Tactics Squadron One, Tasking Marine Aviation Student Handbook, 23 January 1995.

29. Marine Corps Institute, Command and Staff Nonresident Program 8704, MAGTF Education Volume II: Readings, Quantico, VA, date unknown.

30. U.S. Marine Corps, Fleet Marine Force Organization 1992, FMFRP 1-11.

31. Nielson, Jakob, *Top Ten Mistakes in Web Design*, http://www.useit.com/alertbox/9605.html.

32. Forta, Ben, The Cold Fusion Web Database Construction Kit, Que Corporation, Indianapolis, IN, 1997.

33. Beer, Michael A. Notes prepared for class, Leading Change, Publishing Division, Harvard Business School, Boston, MA, 1988.

34. Davenport, Thomas H. Process Innovation, Reengineering Work Through Information Technology, Harvard Business School Press, Boston, MA, 1993.

35. Commandant of the Marine Corps, Headquarters Marine Corps, ALMAR 135/98, Information Technology Advisory 98-01, Marine Corps Standards, 6 April 1998.

36. Commandant of the Marine Corps, Headquarters Marine Corps, ALMAR 154/98, Information Technology Advisory 98-02, Marine Corps Common Component Configurations, 21 April 1998.

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center 2
   8725 John J. Kingman Road, Suite 0944
   Fort Belvoir, VA 22060-6218

2. Dudley Knox Library 2
   Naval Postgraduate School
   411 Dyer Road
   Monterey, CA 93943-5101

3. Director, Training and Education.....1
   MCCDC, Code C46
   1019 Elliot Rd.
   Quantico, VA 22134-5027

4. Director, Marine Corps Research Center.....2
   MCCDC, Code C40RC
   2040 Broadway Street
   Quantico, VA 22134-5107

5. Director, Studies and Analysis Division.....1
   MCCDC, Code C45
   300 Russell Road
   Quantico, VA 22134-5130

6. Marine Corps Representative 1
   Naval Postgraduate School
   Code 037, Bldg. 234, HA-220
   699 Dyer Road
   Monterey, CA 93940

7. Marine Corps Tactical Systems Support Activity.....1
   Technical Advisory Branch
   Attn: Maj J.C. Cummiskey
   Box 555171
   Camp Pendleton, CA 92055-5080

8. Prof. Suresh Sridhar (Code SM/SR)..... 1
   Naval Postgraduate School
   Monterey, CA 93943-5103

9. Prof . Barry Frew (Code SM/FW)..... 1
Naval Postgraduate School.
Monterey, CA 93943-5103

10. Marine Corps Tactical Systems Support Activity 1
Air Defense Systems Division
Attn: Mr. Al Taschner
Camp Pendleton, CA 92055-5080

11. Commanding General..... 1
3D MAW MCAS El Toro
Atten: G-3/G-6 Officers
P O Box 99000
Santa Ana, CA. 92709-9000

12. Commanding Officer..... 1
Marine Aviation Weapons and Tactics Squadron One
Atten: ADT&E Division
PO Box 99200
Yuma, AZ 85369-9200

13. Major Malcolm LeMay..... 2
340 NW 32nd St.
Corvallis, OR 97330